AUG 15 1921

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August 11, 1921

Engineering News-Record

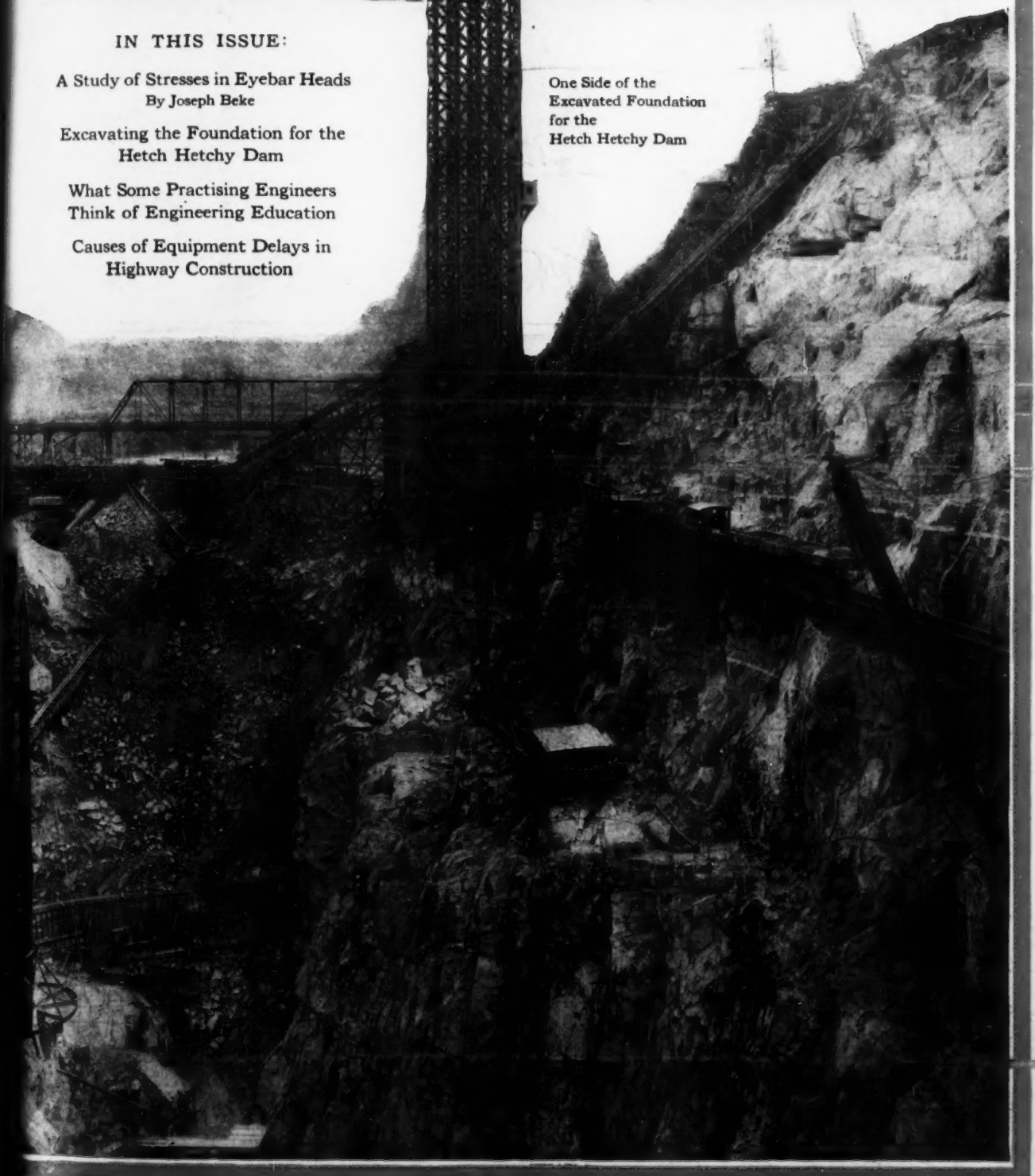
IN THIS ISSUE:

A Study of Stresses in Eyebar Heads
By Joseph Beke

Excavating the Foundation for the Hetch Hetchy Dam

What Some Practising Engineers Think of Engineering Education

Causes of Equipment Delays in Highway Construction



One Side of the Excavated Foundation for the Hetch Hetchy Dam

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 87 — NEW YORK, AUGUST 11, 1921 — Number 6

Better Times for the Railroads

CURRENT returns of railway operating income and earnings are showing consistent improvement. There is some increase in traffic but, more important, there is successful effort to reduce operating expenses. The returns to date are by no means conclusive but they are decidedly encouraging. In fact, only the unsettled labor and wage situations becloud an otherwise hopeful railroad outlook. The government's indebtedness to the carriers is being paid under recent congressional authorization. The sum spent for capital expenditures during federal control will probably be funded. Deficits are being reduced and in some cases are being turned into profits. Even the labor situation has more hopeful aspects than it did six months ago. This is a hopeful situation. It promises some relief to a much distressed industry, and one whose satisfactory condition is necessary to general prosperity.

Proved by the Ages

SENATOR FRANCE in his views on leaving Russia, cabled to the United States by the *New York Times*, merely reinforces what we have heard from time to time for over two years—that the communistic state in Russia is a failure and that those in control have gradually adopted the methods, if not the theories, of a capitalistic régime. However, the senator's statements are rather broader than previous reports and indicate that the powers that be in Russia are fully aware of the completeness of the breakdown of the Marxian experiment and appreciate the necessity of basing their society on private ownership. The peasants are now land-owners, even though the land was secured by confiscation, and form the basis of a society that will demand that rights of private ownership be respected. The Russian lesson has been expensive. It has ended in accordance with prediction—in failure; but the fact of the ending and the reversion to the only theory that, with weak human nature as the predominant factor, the ages have proved workable as the basis of society are worth emphatic and repeated recording.

Experiment and Theory

APT demonstration of the true value of approximate theoretical analysis may be found in the subject of eyebar-head stresses. Rigidly precise analysis of these stresses is impossible, and it might therefore be concluded that construction depends on empirical data, since approximate analysis involves errors of unknown amount. The design of heads has, in fact, been wholly an empirical matter. Now, however, application of approximate analysis to the case shows that very high stresses exist in eyebar heads. These stresses are so high that their existence should be verified or disproved by test. Further, physical test—by strain-gage measurement of eyebars in the testing machine—must be depended upon for the actual determination of the stresses and for improvement of head design. The theoretical investigation is limited to reconnaissance service: it suggests certain probabilities, and marks out a line for experimental research. This is the true service of approximate analysis and, if used accordingly and combined properly with physical experiment, theoretical study will always remain the primary instrument of engineering progress.

Eyebar Stress and Safety

WITH respect to the relation between bridge safety and the high stresses just referred to, it is pertinent to recall that back of the reputation of the eyebar as the most dependable element of bridge construction is a remarkable record of safe performance. Some years ago a bridge in the West fell under circumstances that threw suspicion on one of its bottom-chord eyebars, which was found broken; the incident aroused widespread question because of the very fact that it was unprecedented. Though the case was never investigated, an omission that is still felt as a distinct loss to engineering knowledge, it had value in emphasizing the high degree of safety of eyebars shown by their past record. Because of this excellent record it was quite a shock when Theodore Cooper came before the American Society of Civil Engineers in 1906 with a paper on the great distortion which the head of an eyebar undergoes under even moderate stressing, and it is almost equally disconcerting to read the present results with their high stress figures. But the important thing to remember is that (with normal, ductile steel, at least) this distortion affects the safety of bars in the ordinary sense very little. With special steels and in structures of special type, head distortion is of more direct importance, as in suspension-bridge eyebar chains. The article in the present issue originated directly in connection with such eyebar chains, and the facts as well as the approximate analysis it presents make a strong claim for careful study in this connection. At the same time their application to the design of eyebars for use in ordinary truss bridges is obvious, since no engineer will be willing to tolerate the possibility of his bridge being crippled at loads hardly exceeding his design loads. It may be hoped that the subject will be explored by a thorough test investigation. But the question at issue does not primarily concern safety, as the excellent record of eyebars conclusively proves.

The Engineer in Building Control

IN THE LAST analysis municipal building inspection is a means of waste prevention, furthering both public and private economy. Guarding public safety through prevention of accident, perhaps the most important single objective of building control, is itself an indirect waste prevention, while the other purposes

of building code administration, such as the elimination of slipshod and low-grade construction, are obviously of direct waste-preventive effect. In the light of this fact the statement that "city inspection is inadequate to the demands upon it" made in this journal last week by F. P. Cartwright, is a serious charge, though one that will be admitted by men conversant with building work. The condition referred to is not temporary, or restricted to one city, but will be found everywhere and is permanent in its very nature. It constitutes a problem that is always before us. To make city building inspection thorough enough to guarantee the excellence of construction is quite impracticable. Various interests are at work—for example the Building Officials Conference, whose annual meeting was recently reported in these columns—to make the control of building operations more effective, but a full solution of the problem is not to be hoped for. The sketch of the single case of Rochester as outlined by Mr. Cartwright is typical. Extremely incomplete functioning, scattering of responsibility, and confusion of authority are common defects, which in combination tend to discourage and burden sound building construction. The remedies Mr. Cartwright indicates may be summed up in the term "better co-ordination." What this will accomplish, the author's exposition makes plain. But however efficiently co-ordinated, building control by governmental and insurance authorities can at best furnish only a general check on results. For ultimate assurance of competent building construction the engineer and the architect are the only reliance. To maintain these important agencies in full authority is one of the objects for which we require not only the maintenance of high professional ideals, but as well the establishment of definite relations between public and profession.

Figuring from a False Base

WEEK before last comment was made on the remarkable fact that the shipments of cement in the first six months of this year were 98 per cent of those for the same period of 1920, while shipments of stone, sand and gravel were 87 per cent. These figures, manifestly, are not a correct index of the conditions in the construction field. A more correct picture is shown by a comparison of the contracts let in the respective periods. For example, for the first six months of this year the contracts let aggregated 60 per cent of those let during the same period last year, the figures being based upon *Engineering News-Record* compilations. In other words, the industry is operating at 60 per cent of last year's capacity.

This comparison more truly reflects the feeling of depression that obtains in the industry; but, on broad consideration, is a view based on these figures justified? In other words, is comparison with 1920 the correct way to gage the activity of the construction industry? Bearing in mind that during the first half of 1920 we witnessed the greatest peace-time activity that American business has ever known, we believe that the 1920 base is not a proper one for comparison. If we could, in a year or two, hope to see again the activity of the early part of 1920 we would be justified in accepting that base. There is a general belief, however, that such abnormal activity will not recur for some years. Is it not wise, therefore, temporarily to accept a lower base?

For present thinking, the year 1915 would be better, and 1913 has some features to recommend it, for it was entirely free from war influence. However, 1913 might not be a proper base for we should rightly look for a gradual increase in business, proportionate to the growth of population, between 1913 and the present date.

If 1915 be taken as the base for judging of construction activity it will be generally agreed, we believe, that 1921 is a fairly good year. In saying that we are fully cognizant of the present extent of unemployment and of the back-breaking carrying charges due to expanded organizations and plants. The thinking may not lighten these burdens, but will put us in a sounder frame of mind and prepare us for judging more justly of the business activities of the next few years. Eventually, of course, business will "come back" to the fullness of 1920's activity, when, with full employment for all our workers and improved efficiency, production will exceed that of 1920, even though the value in dollars be less.

Bearing in mind, then, the warrant for comparison of 1915 or 1913, and that the contracts let in the first half of this year, within the limits of *Engineering News-Record's* tabulations, amounted to $579,000,000, there is reason for optimism and faith rather than discouragement. The contemplation of these figures, we freely admit, may give little satisfaction to the builders of industrial plants, whose specialized field is at the foot of the list, with only 17½ per cent of last year's activity, but the showing made by figuring from an earlier base is decidedly encouraging to the industry as a whole.

Because We Lack Faith

POINTING in the same direction as the preceding editorial is an article which appeared in the July 7 issue of *American Machinist*, by Theodore H. Price, editor of *Commerce & Finance*, of New York. He contends that the world is as rich today as it was before the war and that there is no sound reason for discouragement at the tremendous size of the world's debts. He agrees that serious problems are involved in their payment, but contends that an ample margin of values exists to offset those debts, even if not in the liquid form that would be represented by gold bullion. Summing up he says:

"If we had an inventory of all the property of the world as of June 1, 1914, and could compare it with another made June 1, 1921, it would probably be found that the value of humanity's assets had increased sufficiently to offset the debt incurred during the last seven years and that the world is just as rich now as it was before the war. This statement will doubtless be challenged by some who will ask how the losses caused by what is called 'the waste of war' have been met. The answer is that these losses were met by intensive production and effort while the war was being fought."

His closing paragraph sums up the situation with reference to America in admirable fashion:

"Our resources are undiminished, our opportunities are numberless, and the obstacles in the way of their development are chiefly the creatures of our imagination. Faith and industry are qualities that will triumph over all the obstacles that the economist can conjure up."

The same thought is expressed in President Harding's Pilgrim address: "Solvent financially, sound economically, unrivaled in genius, unexcelled in industry, reso-

lute in determination and unwavering in faith, these United States will carry on."

One can come to the optimistic point of view expressed by Mr. Price and President Harding from various angles—and the variety of avenues to the single conclusion is all the more warrant for believing that the conclusion is correct. Faith and confidence are the solvents of the present difficulty. The world is not bankrupt, even though a receiver is needed to insure proper and orderly re-division of assets.

Barring Foreign Port Equipment

LAST WEEK the New York City Board of Estimate and Apportionment, in approving of the calling for bids for the crane equipment of two of the Staten Island piers, added the condition that the equipment must be of American manufacture. This was done because of representations that foreign manufacturers, chiefly German, were expected to seek the business and, if price alone were considered, would capture the contracts. It was contended that the foreign cranes were not as good as American equipment of the same type and that an American city should favor domestic manufacturers in order to give employment to American workmen. The specifications, it is stated, favor the German manufacturers due to the influence of the foreign lessees of the pier, who, under the curious theory of port development held by the present city administration, have almost complete control of pier design and equipment.

What proportionate weight these arguments had with the board cannot be ascertained, nor has an engineer's report to the board on the subject been made public. The decision, however, is one of exceptional interest in connection with our present export and import trade situation and involves principles of importance to American engineers and manufacturers.

Of the statements made, the more important is the contention that the foreign cranes are inferior to those of American make. This is a broad statement, susceptible of proof only by the most painstaking inquiry into the service records of both foreign and American equipment. Lacking such an inquiry it is not a sufficient argument for excluding the foreign equipment.

Allied, however, to this contention are the long-time performance, maintenance and repair factors, to which much weight must be attached in reaching a decision. The German manufacturer, under present necessity, is looking for any market into which he can break. Obviously he cannot look here for a permanent market in dock cranes and similar port equipment; his present opportunity is a temporary one, due to the war unsettlement. His interest in long-time performance would be less, therefore, than that of an American firm which is looking for repeat orders, and whose reputation would be very much jeopardized by failure of its equipment in so important a location as the Staten Island piers. Moreover, American firms would be interested in the maintenance, and could more readily take care of repairs.

In the future, too, when European, and particularly German, costs rise, repair bills might mount to high figures. New York is buying cranes not for a three or a five-year, but for a twenty-year use. Consequently, it is justified in looking pretty well into the future and of taking into consideration, not present-day conditions but those that will obtain when we are some four or five years further removed from the abnormal conditions created by the war.

To the argument that an American city should be willing to spend about $100,000 more for cranes that can be bought abroad for probably $400,000, on the plea that it would help feed unemployed American workmen, relatively little consideration need be given here. Everyone desires to see our unemployed put to work. However, *all other conditions being equal* we question whether New York City, whose tax rate is already very high and under protest by the taxpayers should saddle its people with the additional expense. No stockholder would approve his board of directors spending $100,000 extra in a $400,000 deal on philanthropical grounds.

We are fully aware, of course, of the outcry that would be raised against public officials who, under present conditions, would let contracts to foreign, and particularly German, firms. In fact, a majority of the public itself might take the ground that American workmen should be favored even at higher cost, but economically the contention cannot be maintained.

Aside from these factors is another point that requires consideration, namely, that of adaptability to American workmen and to the other items of dock equipment. There can be little doubt that the American workman works best with American tools. He is familiar with American systems of control. He knows how to gage his operations to a nicety due to long practice with American equipment. Moreover, he maintains best the type of equipment with which he is familiar. Further than that, however, the equipment must fit in with everything else of a mechanical nature involved in dock operations, with our types of freight cars, and our locomotive clearances, with our motor trucks and other mobile equipment.

It may be contended that all of these matters can be covered by specifications. Theoretically, that is true—true in the same sense that a manufacturer of heavy machinery having seen a new type of equipment built by a competitor can quickly produce a similar design. Yet we know from long and disastrous experience that this manufacturer will require months and possibly years to work the "bugs" out of the design. Similarly, there are many intangibles in fitting in a system of cranes to all manner of American equipment.

On the whole, therefore, on the grounds of maintenance, repairs and adaptability there is reason to believe that the decision of the New York board to eliminate foreign equipment may be sound. The engineer's report, not now available, would shed light on the situation. It is well to emphasize, however, that a decision of this sort is essentially an engineering matter. The better method of procedure would have been to allow the foreign bids to be received—on specifications, however, untainted with foreign practice—and then, with the differential in first cost available, to weigh against the saving in price the various considerations that have here been set down.

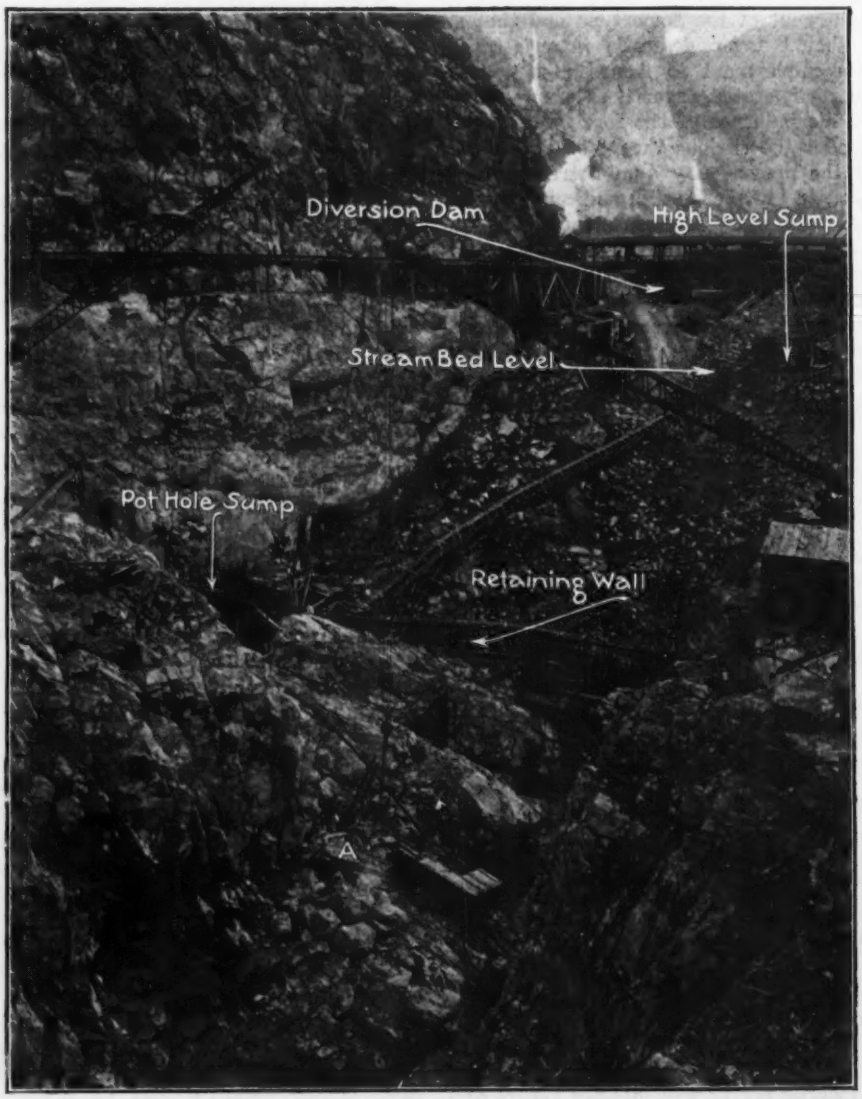
There are obvious limits to the differential in first cost which would be offset by the considerations discussed. What that limitation, even as a percentage figure, is cannot be lightly determined. In fact, much would have to be left for judgment even with the first-cost bids at hand, but certainly the soundness of the decision, economically, can be questioned when the foreign product is excluded without giving the foreigners an opportunity to bid.

Excavating the Foundation for Hetch Hetchy Dam

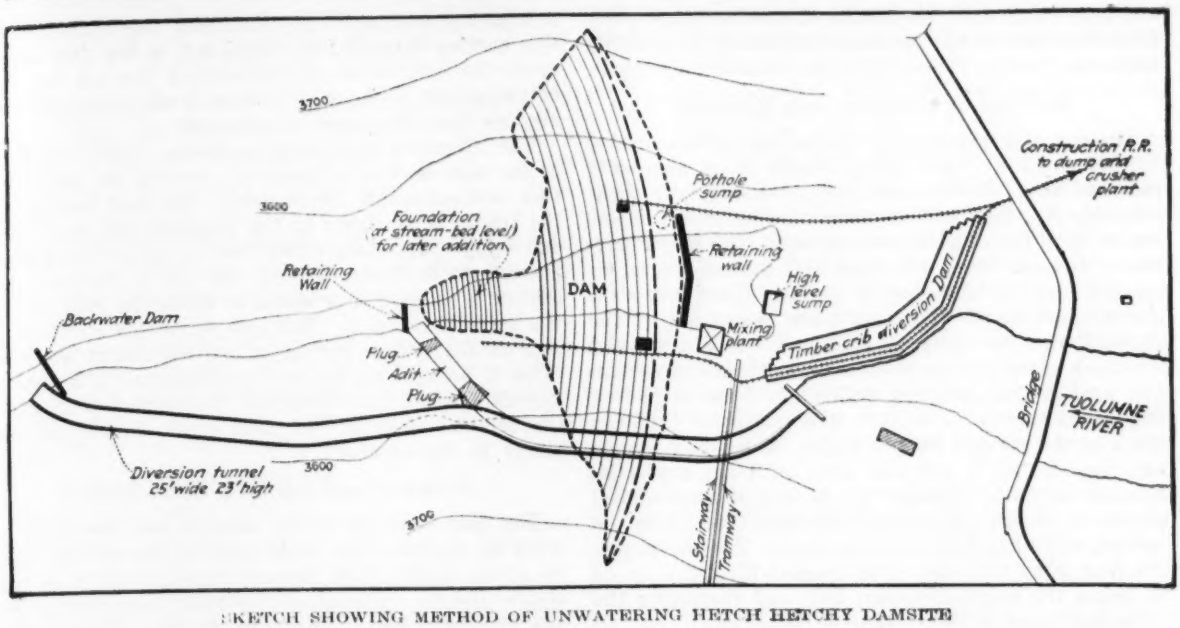
Open Cut Method Used on New San Francisco Water-Supply Structure Although Depth Reaches 146 Ft. Below Flood-Water Level—Favorable Bedrock Formation Found

IN ORDER to remove material overlying the bedrock at the Hetch Hetchy dam, now under construction for the water-supply of the City of San Francisco, it was necessary to divert a stream flow of about 12,000 sec.-ft. and excavate to a maximum depth of 146 ft. below flood-water level. Bedrock was found at depths ranging up to a maximum of 113 ft. in the deepest place, below the bed of the stream, although even in the potholes there were very few spots where the depth exceeded 100 ft. When the work began the question of how the water could best be kept out of the excavation was complicated by uncertainty as to the porosity of loose material on the upstream side. A large amount of percolation into the excavation was expected; in fact, the prospect of having to work under compressed air was so definite that the lower portions of pneumatic caissons were brought to the site to be in readiness when needed. However, the excavation was completed in twenty months by the open-cut method without either flooding the excavation or utilizing the full capacity of pumps that had been installed for unwatering. Two factors in the success of the open-cut method are the tightness of the cut-off wall for diverting surface water and the presence of impervious strata in the loose material on the upstream side of the site. The location in the canyon selected for the damsite is such that (1) the foundation slopes upward in a downstream direction, (2) the walls of the canyon converge and, (3) the extreme irregularity of the granite bedrock on bottom and sides should tend to make the concrete a unit with the bedrock itself. The tunnel built to divert the flow of the river through the solid rock south of the site is 23 x 25 ft. in cross-section and 900 ft. long. The capacity of this tunnel proved to be sufficient to carry the flood waters during the excavation of the foundation. In the accompanying sketch the various elements in the construction operations are shown.

Great care was taken in constructing the diversion dam. Not only was it desired to turn as much of the stream flow as possible into the tunnel, but also to reduce to a minimum the percolation below the stream-bed level. To accomplish this a trench was excavated across the natural stream bed almost down to the ground-water level. In this a line of Wakefield sheet-piling extending entirely across the channel was driven to a depth of 6 to 8 ft., this depth being sufficient to reach a more or less impervious stratum which, it was hoped, would aid in decreasing percolation. With this sheet-piling as a cut-off wall, a timber crib dam was built up to a height of 40 ft. and filled with rock. On its upstream side the crib was faced with a double layer of 3-in. plank. Burlap and tar were used between the layers and the outer layer was caulked



GENERAL VIEW OF UPSTREAM SLOPE OF EXCAVATION OF HETCH HETCHY DAM
Canyon in foreground extends down to a level 48 ft. below "A"



SKETCH SHOWING METHOD OF UNWATERING HETCH HETCHY DAMSITE

so as to make the dam as tight as possible. Asphalt was run into the crevice between the crib face and the sheet-piling cut-off wall.

Fine material was dumped on the upstream side of the diversion dam to aid in silting up cracks in the structure. On the downstream side, below the level of the crib-dam foundation, rock from the excavation was filled in from time to time as a facing on the slope to prevent a sloughing down into the pit that might endanger the crib foundation.

As the diversion dam was 100 to 300 ft. above the upstream toe of the permanent dam, the upstream slope of the excavation was allowed to seek its own angle of repose until the work was down 63 ft. below the foundation of the diversion dam. Here a trench was excavated and a concrete retaining wall 30 ft. high was built up to hold the toe of the slope. The top of this wall is 58 ft. below the foundation of the diversion dam. Thus, as the material on this long slope had found its angle of repose before the retaining wall was built, the face of the slope did not move materially after this stage of the work. A considerable flow of water came continually from beneath this wall but it was well anchored at both abutments and served effectively in holding back the material while the excavation was carried on to lower levels. No difficulty was experienced in the sloughing down of material under the wall into the excavation below.

Of the water that came through the diversion dam, that which could be caught at a sufficiently high level was collected high up on the slope in an old cofferdam that was made to serve as a sump. At a lower level, near the north end of the retaining wall, a large pothole served as a second collection basin from which the water was pumped back into the stream above the diversion dam, a lift of about 90 ft. Water from lower levels was delivered into the latter sump, two lifts being required to bring up that collected at the lowest points in the excavation.

At the downstream end of the diversion tunnel conditions were more favorable for keeping water out of the excavation. Only a very low backwater dam was required because the bedrock here was near the surface and the excavation was more than 400 ft. upstream from the end of the tunnel. At a point 425 ft. upstream from the backwater dam a small retaining wall was built to hold back the loose material. The pumping installation near the downstream end of the excavation varied to suit changing conditions of the work and ranged from a 6-in. pump working part time to a 6-in.

VIEW DOWNSTREAM FROM UPPER RETAINING WALL AT HETCH HETCHY

and a 14-in. pump. The length of the discharge pipes from these pumps was decreased materially by pumping into the diversion tunnel through a construction shaft.

Methods of Handling the Material

The material excavated in uncovering bedrock totaled 161,947 cu.yd. of which about 96,000 cu.yd. was solid rock and about 66,000 cu.yd. was loose material. Considerably less than half the total excavation was below the level of the original stream bed. The major portion of the excavation was done with a steam shovel on crawling treads delivering to 4-cu.yd. dump cars on a narrow-gage track. The cars were hauled out of the excavation on the upstream side by 17-ton dinkeys and when the grade became steep a counterbalanced system was used so that incoming trains would aid in pulling out loaded trains. This plan was continued until the track grade reached 20 per cent. A hoisting engine was then installed, and was used until the grade became 34 per cent. During the last days of steam-shovel service in the pit, the shovel delivered directly to the 2-cu.yd. skips handled by the derricks. The shovel was removed when the excavation reached El. 3,435, or 67 ft. below the original stream bed, and thereafter the skips took out a total of about 20,000 cu.yd.

Particularly in the lower portions of the work, progress was slow on account of the steepness of the canyon walls. The danger from falling rock was such that men could be worked only at one level at a time. The steam shovel usually worked 10-ft. lifts on alternate sides of the canyon, scaling crews above being shifted so as to avoid working above the shovel.

All the spoil was delivered to a dump in the valley above, along the line of the railroad to the crusher plant. The railroad location for handling spoil is entirely suited to bring in sand and gravel from the crusher plant to the concrete mixing plant, and will be used for that purpose.

Insure Tight Bond With Bedrock

The natural gorge uncovered by the excavation contained many potholes, some of them ranging up to 20 or 30 ft. in diameter. The gorge runs through solid granite practically all of which has a very smooth, water-worn surface. Because this smoothed surface would not give a firm bond with the concrete, the contract calls for the removal of all water-worn surfaces, or at least their scarification to the extent that a firm concrete bond would be assured. The same requirement applied to rock whose surface had been weathered or which for any other reason had a scaly or flaky surface. The contractor has the option of hand work or sandblast in finishing the surface to specifications.

As an aid in insuring watertightness a cut-off trench was made 15 to 20 ft. back from the upstream face of the dam. This trench runs from the bottom of the excavation to the crest of the dam on either side of the canyon and ranges from a 15 x 20-ft. cross-section at the bottom to a much smaller size near the top.

All seams were followed into the rock until they "pinched out" thus affording bond for concrete against solid bedrock. The specifications permitted grouting seams where necessary but because no seams of great depth were encountered this was not resorted to. As an indication of the tightness of the bedrock it is pointed out that although the entire flow of the river was carried through the tunnel only a few feet away from the excavation and paralleling the cut for its entire length at a much higher level, there was no seepage from the tunnel into the cut.

The diversion dam served a double purpose in that it was also used as a means of carrying the construction railroad across the channel. The final location of the tracks is as shown in the accompanying plan. By extending spurs along either side of the canyon it was possible so to locate derricks that either the north or the south railroad spur would be under the boom of all the derricks but one. This one served the middle section in the lowest portion of the excavation and the skips it brought up had to be transferred to a second derrick. After completing the uncovering of bedrock the derricks were left in place to be used in placing plums in the concrete.

Workmen Get Air Ride Twice Daily

The men working at the damsite are housed in a camp on Hodeau Flat from which a five-minute walk on a very slight grade brings them to a point on the Hetch Hetchy railroad immediately overlooking the site and about 500 ft. above the bottom. Early in the work this drop was traversed by an incline on which a car was operated by a hoist. A cableway has since been thrown across the site and a skip takes the various shifts to and from any desired point in the foundation itself. The skip ordinarily carries about 30 men and operates on a 2¼-in. cable. With this arrangement the men are taken to and from the work very much more quickly than would have been possible on the incline. This skip gives a birdseye view of the entire site and the sensations of riding in an airplane. The round trip for a loaded skip, including loading and unloading, occupies about three minutes.

Three shifts are operated in the foundation excavation with working hours from 7 a.m. to 3 p.m., 3 p.m. to 11 p.m. and 11 p.m. to 7 a.m. The night shifts, however, are much smaller than the daylight shift because work on the slopes and in the more difficult locations cannot safely be done at night. Adequate illumination for night work is supplied by 1,000-watt electric lights spaced about 75 ft. apart on two cables some 200 ft. above the lowest point in the excavation.

For the purpose of checking up excavation yardage as well as convenience in plotting exact locations and elevations on a progress chart, a plan of the foundation area has been laid off in 25-ft. squares. All prominent points or points where the grade changes abruptly are marked with red paint on the rock and plotted on this plan.

A base line across the gorge above the dam is used as a reference for all locations, these locations being given by two figures, one representing the ordinate measured on the base line and the second the right-angled offset therefrom. A third figure gives the elevation. Thus the marking 5 + 80 ⅄/75/3456' locates a point 580.4 ft. from the end of the base line, offset 75 ft. from it, and at El. 3456.8.

The work on the Hetch Hetchy dam is under contract to the Utah Construction Co. and is under the general supervision of M. M. O'Shaughnessy, city engineer of San Francisco. C. R. Rankin is resident engineer at the dam site for the city and A. E. Paddock is construction engineer in charge for the contractor.

Concrete Building Plant Layout for Limited Room

Cableway Over Siding Unloads Cars—Basement Bins and Mixer Serve Inside Tower—All Concrete Spouted

By Carl A. Markgraf
Cincinnati, O.

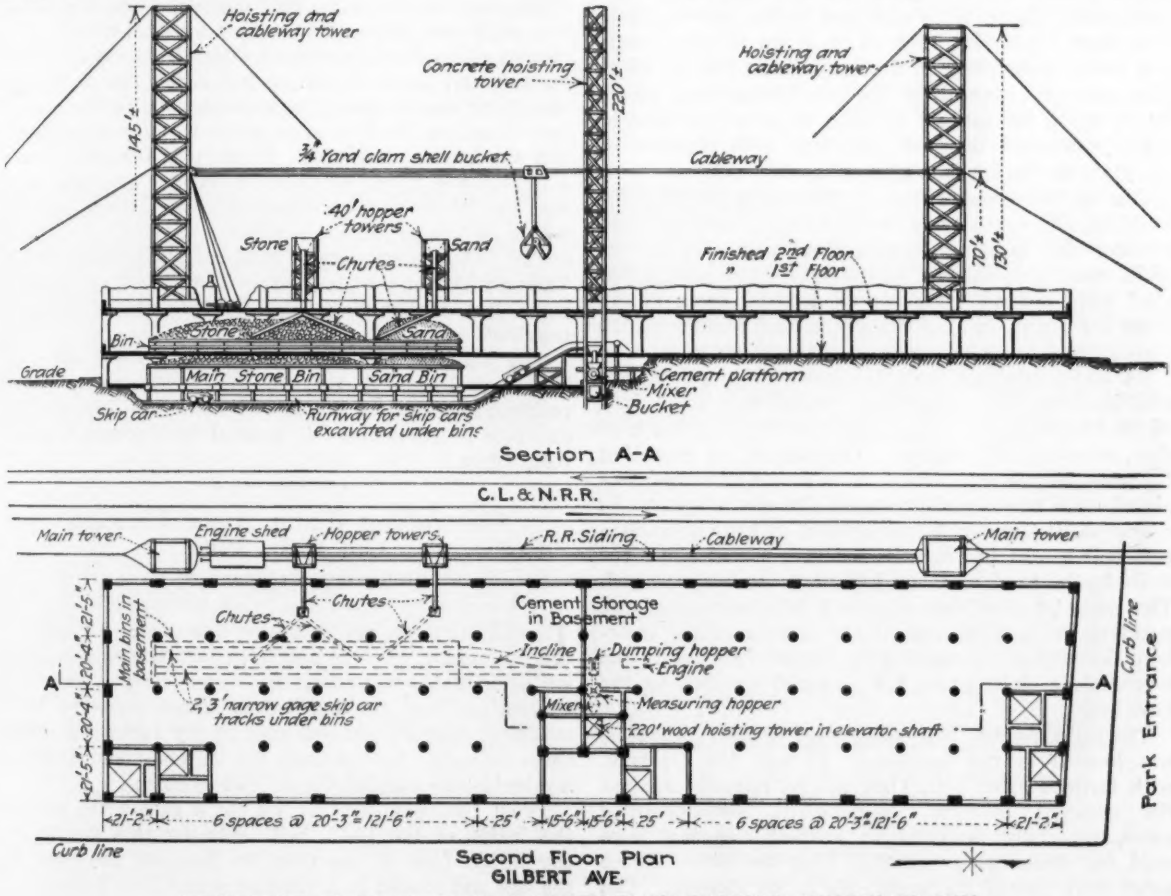
A CABLEWAY unloading outfit and inside storage and concrete gravity plant distribution were ingeniously combined to meet conditions of limited exterior plant space in building the Baldwin piano factory at Cincinnati, Ohio. The unique feature was the cableway unloading unit. By means of this cableway a large-volume stone and sand handling operation was conducted in a 20-ft. strip occupied by a siding along one side of the building.

the exception of the special excavator operation described in *Engineering News-Record*, Feb. 17, 1921, p. 314. In general, construction interest is attracted only by the equipment for mixing and placing the concrete.

Plant Plan and Equipment

As shown by the plan, the building is bounded by the C. L. & N. R.R. and two busy thoroughfares. An old four-story structure occupied the north half of the site for the new building. In order to interfere as little as possible with factory operations, it was decided to construct the new building in two halves, the old structure not being razed until the south half of the new was completed and put in operation, so that production would be interrupted for the minimum time.

Following from these conditions the general considerations governing the plant plan and equipment were:



CONCRETING PLANT PLAN FOR BALDWIN PIANO FACTORY, CINCINNATI, OHIO

Structurally the building does not depart from familiar practice. It is reinforced concrete with brick curtain walls carried on concealed spandrel beams, and is approximately 85 x 370 ft. in plan and seven stories high, with a basement under the south half. The average story height is 13 ft. The typical floor bays are 20 ft. 3 in. square and flat slab construction is used practically throughout. The floors are designed for 150 lb. live load; the rough slab being 7½ in. thick with a ½-in. top coat of special finish placed with the slab. The basement excavation was steam-shovel work, with

(1) Although the building was to be constructed in two parts, economy indicated that the equipment should be arranged to handle both parts with as little change as possible. (2) Having no working space at the sides or north end of the building, it would be necessary to place a large part of the equipment and provide storage for materials inside the building. (3) Practically all building materials would be received by rail in car lots. (4) Because of the limited clearance on the existing siding at the west side of the building, ordinary unloading equipment could not be employed.

All concrete was to be spouted to position. By placing the concrete hoist in the elevator shaft of the clock tower, it was possible to concrete both halves of the building from one hoist. This location of the concrete tower in turn determined the location of the main concrete plant in the west central portion of the basement. The location of the concrete plant and railroad siding determined the position of the storage for sand, stone and cement. The general arrangement of the building and equipment is shown by the sketch plan and elevation.

Material Handling Equipment

The unloading equipment for handling the shipments of sand and stone, totaling some 18,000 cu.yd. consisted of a ¾-cu.yd. clamshell bucket operating on a cableway suspended from two towers. These cableway towers, which straddled the railroad siding, were located approximately 25 ft. from each end of the new building. The south tower was 12 x 15 ft. x 145 ft. high, while the north tower was 15 ft. square and 130 ft. high. The cableway connecting the two towers was placed 70 ft. above the ground in order to clear two bridges which connected the new buildings with portions of the plant on the opposite side of the railroad.

During the construction of the south half of the building, the south cable tower was equipped with an elevator for hoisting terra cotta, stone, brick, etc., while such materials as forms shores and reinforcing steel were hoisted by means of a 30-ft. boom swung from the same tower. The south half completed, the elevator and boom were moved to the north tower.

At 50-ft. intervals from the south cable tower, two additional towers were erected. These were 7 x 8 ft. x 40 ft. high and supported large wooden receiving hoppers, provided with chutes. The engine for operating the clamshell bucket and the cableway carriage was placed on a raised platform near the south tower. In operation, the material was hoisted in the clamshell a sufficient height to clear the bridges, moved along the cable to the sand or stone hopper tower and dumped. The material was then conveyed by chutes, through openings in the steel sash, to the interior of the building. The chutes terminated in temporary holes in the second floor slab, where the material dropped to the bins below.

The main storage bin, constructed of heavy timbers, was located in the basement. It was 120 ft. long, with inclined sides 8 ft. high, braced laterally against the adjacent columns. Quick-shift, hand-operated gates, especially designed to prevent clogging were used for discharging material from the bins. These gates were placed staggered, 3½ ft. on centers. The maximum capacity of this bin was 365 cu.yd. stone and 180 cu.yd. sand. An auxiliary storage bin with a capacity of 350 cu.yd. of stone and 180 cu.yd. of sand was later located on the first floor. The material from this bin was fed to the main bin through temporary 8-in. slots, 4 ft. long, spaced 4 ft. on centers in the first floor slab along the center line of the bin.

Cement was stored in the basement just west of the mixing plant, and was unloaded direct from cars to mixer or storage, as desired, by gravity rollers.

A 220-ft. concrete hoist tower gave a working radius of approximately 185 ft. The first chute was hung from a 40-ft. boom and the other chutes were suspended from gin pole and tripods. Standard 30-ft. chutes were used.

Skip cars conveyed the material from the bin to the mixer. These cars holding 16 cu.ft. of stone and 8 cu.ft. of sand were of special design to fit cramped quarters and were fabricated in the contractors' shop. They were operated on narrow-gage tracks in a narrow passageway excavated under the entire length of the bins. The tracks had a 4-ft. clearance under the bins and ascended to the first floor level through a 7 x 8-ft. opening in the first floor slab. The skip cars were operated together, one returning empty from the mixer while the other carried a charge to the mixer. A three-drum hoist engine operated both skip cars, the bucket in the concrete hoist and a 30-ft. boom at the top of the tower. The concrete was mixed in four-bag batches.

To mix and hoist the concrete there was a crew of eight men, as follows: Two operating the bin gates for sand and stone, two supplying the mixer with cement either from storage or direct from the cars, one opening and emptying the cement sacks, one in charge of mixing and dumping the concrete, one in the crows-nest directing the flow of concrete through the chutes, and one hoisting engineer. Steam was furnished from a local power plant. A crew of six men and one foreman on the floor was sufficient to move all chutes, and do the necessary tamping and grading. This made a total of 14 men required to mix and place the concrete. The efficiency of the plant layout is reflected in this low labor cost of handling the 12,000 cu.yd. of concrete required.

The building was designed by the Detroit office of Lockwood-Greene & Co., F. M. Erwin being their resident engineer. It was erected by The Ferro-Concrete Construction Co., general contractors, Cincinnati, Ohio.

Controlling Water After Blowing Out 16-In. Plug

By M'Kean Maffitt
Superintendent Water and Sewers, Wilmington, N. C.

IN MAKING repairs to a pipe line after blowing out a 16-in. plug we were unable to yarn the plug because we could not keep down the water coming into the excavation from leaking valves which were in such condition that we did not dare to try further to close them entirely. To overcome the water—about 100 gal. a minute—we adopted the following kink:

From ½-in. gum packing we cut a gasket the size of the inside of the 16-in. bell. Placing this gasket on the inside face of the plug we inserted the plug in the bell and braced in a common screw jack behind the plug. As we tightened on the jack we regulated the plug so that we had an even joint all round. With a very few turns of the jack we had the water cut off completely. The hydrant nearest to the job was opened so that there would be only the head of water from the plug to the outlet of the hydrant. When the water was cut off we yarned and poured the plug in double quick time. The only difficulty was in holding the gasket against the face of the plug and that was overcome by tying it on with strong cord going all around the plug. Had we tried to yarn the plug with the water in the hole we would have had a very wet joint, whereas it was as dry as new work.

Side Slopes of Drainage Ditches in Unstable Soil

Engineers Advise 1 on 3 for Buckshot Clay After Study of Caving Slopes — Change in Dredging Plant Necessary

A PROBLEM in the design of dredged drainage ditches for soft and unstable soil is the relation of the side slopes to caving and sliding of the banks, this problem having a special bearing upon the permanence of the ditches and their future requirements for maintenance. Economic advantages of a much flatter slope than that generally used are indicated by an investigation of certain ditch systems in Missouri, showing the economy of greater first cost for larger excavation in order to secure more stable ditches which will retain their efficiency for a considerable period. Where drainage ditches become badly obstructed, either they must remain largely ineffective or costly reconstruction may be necessary to restore the original flow capacity, this work sometimes involving special bond issues during the life of the original bonds for the construction of the ditches.

FIG. 1. IMPROVING CAVED DRAINAGE DITCHES
A—Ditch ahead of dredge. B—Ditch behind dredge

In three drainage districts established in Pemiscot County, Mo., under the direction of the county court, the ditches built during a period of about fifteen years were 5 to 8 ft. deep, with specified side slopes of 1 on 1. The amount of caving was considerable in some localities, but was attributed for the most part to poor workmanship, except where water-bearing sand was encountered. In 1919 reconstruction was begun in order to provide more effective drainage, the ditches being enlarged and their depth increased to from 10 to 16 ft. With increased depth, additional caving began early in 1920, when the ground had been saturated by heavy rains, so that in places the enlarged ditches were little if any deeper than in their original condition. This condition greatly reduced the value of the improvement to all of the lower lands in the districts affected. Average examples of these ditches are shown above.

Such a condition had not been foreseen when the reconstruction was undertaken, and by direction of the county court an investigation was made by the Elliott & Harman Engineering Co., Peoria, Ill. The report attributes the difficulty entirely to the caving banks, as the material spreads so as to cover the bottom of the ditch and thus raises the grade. The amount of silting from surface soil washed into the ditches is considered negligible. The remedy recommended is the reduction of the slopes from 1 on 1 to 1 on 3, but using 1 on 1½ in certain places where floating dredges are now installed, with changes in dredging equipment.

Joint clay or "buckshot" clay is the soil principally encountered, but sand or sandy loam occurs on ridges. The clay is composed of very fine particles and is very porous, having numerous well-defined joints or cracks through which water can penetrate the mass readily. When saturated with water the clay becomes soft and mushy, so that when a block of clay slides into the water it softens and flows over the bottom of the ditch. Caving appears to begin near the bottom of the slopes, due to this softening of the clay.

An abstract of the conclusions arrived at and the recommendations made in the report to the county court is given below. These recommendations have been practically adopted by the court and the improvement is now proceeding along the lines recommended. None of the work with slopes of 1 on 3 has been constructed as yet, but a dragline excavator suitable for the heaviest portion of this work is being installed in one of the three districts. Arrangements have been made with the contractor to complete that part of the work which can be done with the present floating dredge, leaving for later consideration the work which properly requires a dragline machine. The estimated quantities for the three districts aggregated 7,057,200 cu.yd. for slopes of 1 on 1, with a cost of $1,609,452, including outlets, right-of-way, engineering and administration. With the flatter slopes of 1 on 1½ and 1 on 3, as now recommended, the quantity is increased to 9,389,280 cu.yd. and the total cost to $2,199,592.

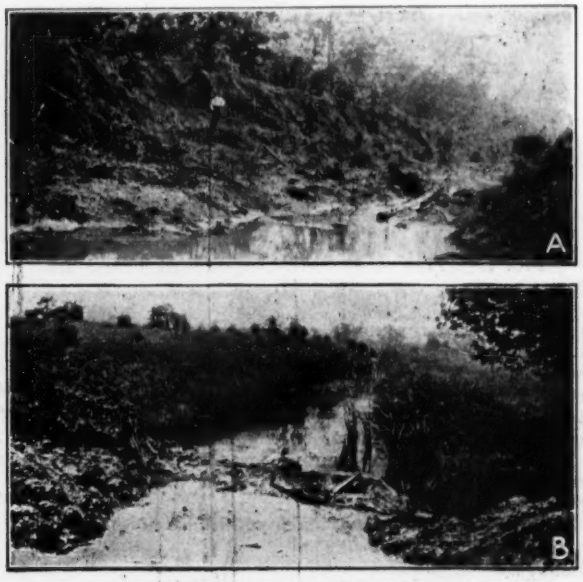


FIG. 2. CAVING DRAINAGE DITCHES
A—Main ditch. B—Lateral

1. The ditches which are being reconstructed will not be stable and will not give effective drainage if they are finished with side slopes of 1 on 1.

2. Caving has not been prevented by the care exercised by the contractors and engineers in cutting slopes exactly 1 on 1, instead of permitting the dredge bucket to run freely and thus cut the ditches wider at the bottom and with steeper slopes.

3. The floating dipper dredges installed for the reconstruction work cannot readily form slopes flatter than 1 on 1 and at the same time place the material at a sufficient distance from the bank to prevent this material slipping back into the ditch if the banks cave. The flattest slope they can make is 1 on 1½, and with such a slope they cannot deposit the material at such a distance as to leave an adequate berm, except where it is dumped behind the old spoil banks.

4. The work which was done in 1920, with slopes of 1

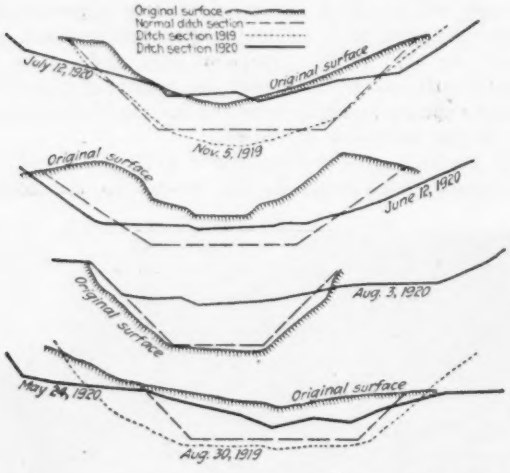


FIG. 3. TYPICAL DITCH SECTIONS IN PEMISCOT COUNTY, MO.

on 1½ has gone through the winter and wet season and is in much better condition than where the slopes were constructed at 1 on 1, but it is not satisfactory from the standpoint of stability, as the slopes show much caving. It is pointed out that ditches with 1 on 1 slopes have stood well until the wet weather of winter and spring, or until the water was drawn down to a low level, the critical time for the caving of banks being when the water is low and the ground is saturated.

5. In order to have reasonable assurance of the stability of the banks and proper conditions for economical maintenance, the slopes should be constructed 1 on 3, leaving a berm between the ditch and spoil bank of a width about three times the average depth of the ditch. The spoil banks should be made with slopes as flat as the equipment available will permit, so as to encourage the landowners to put the spoil banks under cultivation. Ditch slopes of 1 on 3 will be comparable with the standard slopes for levee construction in this section. They should be planted with Bermuda grass, and kept clipped or grazed and free from any other vegetation.

6. It is recommended that the court should issue orders that will enable the engineers to modify the cross sections and the reconstruction program so that when the ditches are improved they will be permanent structures which may be maintained readily for the effective drainage of the lands.

7. In this work, the floating dredges already in service should be used to complete the smaller ditches with slopes of 1 on 1½ where they can do this effectively. The larger dredges which have to make double cuts should cut one side of the ditch only, not disturbing the old spoil bank but putting the new material behind it. In this way they can excavate from 40 to 50 per cent of the required ditch cross-section, and reach the outlet with one side of the ditch excavated in less than half the time it would take to complete the full cross-section. The remaining portion of the larger ditches, and such of the smaller ditches as the floating dredges cannot handle economically, should be constructed with dragline machines, making the flatter slopes and wider berms recommended in the report.

Seashore and Track Protection on an Irish Railway

Concrete Blocks with Protruding Quarry Stones Chained Together Along Beach—Ballast Covered with Concrete

ROWS of large concrete blocks chained together and supplemented by heavy quarry blocks laid between the rows is a type of shore revetment used by the Dublin & Southeastern Ry., of Ireland, to protect a part of its line which is situated close to the seashore between Greystones and Wicklow. A layer of concrete is also placed over the stone ballast to prevent the waves from washing it away. This revetment and the track protection are shown in the accompanying drawing. The threatened section of line is about 10 miles long, and the protective work aggregates 6½ miles, but is not continuous, as there are a number of small cuts and fills. To a great extent the line conforms to the ground level and is 40 to 70 ft. distant from the water. On the land side is low ground subject to periodical flooding.

Concrete blocks 9 x 3 x 3 ft. are used principally, weighing about 6 tons each, a small number being only 3 ft. and 6 ft. long. They are placed close together and connected by chains laid through them and embedded in the concrete, or by short lengths of bars or chains similarly embedded. The concrete is composed of 1 part cement to 5 parts sand and gravel, with rough stone blocks set in it to form an irregular surface and reduce the amount of concrete. A cubic yard of block averages 3 cu.ft. of cement, 15 cu.ft. of sand and gravel and 9 cu.ft. of stone displacers. These blocks are cast in place, as a rule, in rough wood forms, but some have been cast on the high ground and then rolled into the desired position. In addition to the rows of blocks, at some points similar 2-ton blocks are placed in intermediate spaces, rough rock rubble being deposited between the blocks to protect the face of the slope, as shown.

PROTECTIVE WORK ALONG THE SEACOAST; DUBLIN & SOUTHEASTERN RY., IRELAND

Track Protection—Upon the sandy subgrade there are two rows of stone spalls and ballast 22 in. wide, and 8 in. deep, to support the ties, concrete being filled

between the ties for a total depth of 12 in. The edges of the concrete are rounded off and are reinforced by longitudinal steel wires. Concrete is laid also between the ballast and the first row of blocks on the shore side, loose stone being laid on the outer side to cover the sand as far as the property fence. The track has the Irish gage of 5 ft. 3 in. and is laid with bull-head rails in cast-iron chairs.

Railway traffic had been interrupted frequently by storms before the construction of the protective work, this part of the line being out of service for three weeks after a storm in November, 1915. Relocating the line farther back from the sea at different points has been proposed, and a ten-mile diversion has been authorized, but though there are no engineering difficulties involved the cost would be considerably greater than that of protective works. Up to the end of 1920 the work had cost about $225,000 (at normal rate of exchange). The work is done by railway forces. This system of protection was invented by C. E. Moore, chief engineer of the Dublin & Southeastern Ry.

Structural Steel Top Story on Concrete Building

Large Floor Space, Exceptional Light and Ventilation Needed—Sash Panels Hinged at Top

SPECIAL design of industrial buildings to secure economy in meeting special manufacturing conditions is illustrated by the combination of reinforced concrete and structural steel construction in a three-story pattern shop and core building 83 x 57 ft. Storage for patterns and cores is provided on the first floor, and the second floor is for the manufacture of metal patterns. For these two stories reinforced-concrete construction was suitable and economical, with panels approximately 20 x 18 ft. The general design of the building is shown in Fig. 1 and the steel roof truss details in Fig. 2.

For the core-making shop on the third floor, however, it was desirable to have larger unobstructed floor space, with exceptionally good light and ventilation on account of the smoke and gases produced in manufacture. With steel construction the central row of columns could be omitted and the so-called Pond truss, forming a high monitor, gave opportunity for ample skylight and ventilation space. It was necessary also to provide against roof condensation and dropping moisture, which would have required special construction in a concrete deck. Further the cost of a steel truss roof with gypsum tile covering was found to be about 15 per cent less than that of a flat concrete roof with raised skylights, exclusive of the provision for condensation in the latter case.

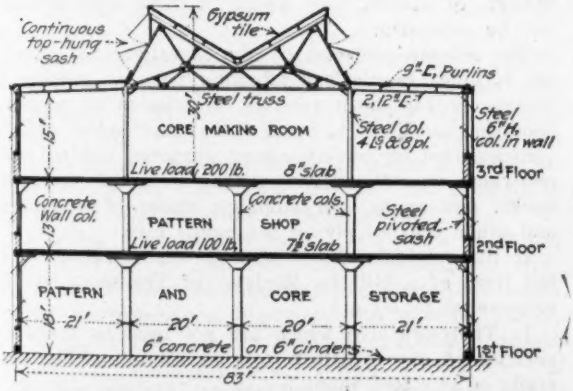


FIG. 1. CONCRETE BUILDING WITH STEEL TOP STORY

Steel columns are anchored to the girders over the concrete wall columns and the two interior rows of columns, the walls being mainly of steel sash on low brick spandrels, as in the lower stories. The two 21-ft. side bays of the roof are flat, with pairs of channels for the joists and single channels framed between them for the purlins. Steel trusses of the Pond or butterfly type span the central 40-ft. space, forming a wide monitor with gypsum tile on the top and swinging sash for the sides. The sash panels are hinged at the top so as to give a freer opening than with sash pivoted at the middle, as in the side walls.

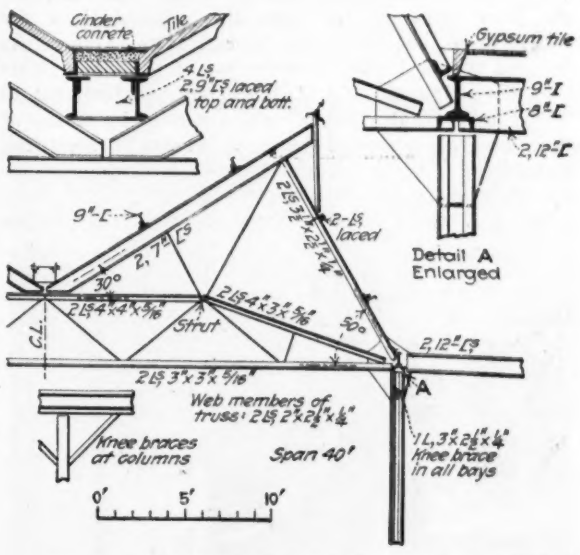


FIG. 2. ROOF TRUSS FOR SPECIAL VENTILATION

This building, which is part of the enlargement of the Chain Belt Co.'s plant at Milwaukee, Wis., was designed by Frank D. Chase, Inc., engineers, Chicago.

Los Angeles Aqueduct Irrigates Large Area

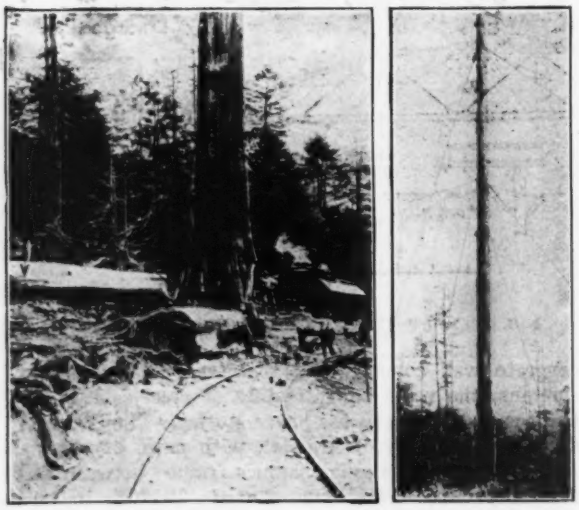
Many extensions have been made in recent years to the pressure pipe irrigation system in the San Fernando Valley which is supplied by water from the Los Angeles aqueduct. There is now under irrigation in this valley about 76,000 acres or seven-eights of the area that could be irrigated by canals from the aqueduct supply. In addition to extending the pipe system various means for increasing storage capacity have been employed to offset the demand for an excessively large volume of water at certain times of the year. Encino reservoir, which is under construction on the south side of the valley above the main canal, will hold about 3,000 acre-feet. On the Westgate project the Stone Canyon tunnel has been driven from the south portal to within 50 ft. of completion and the Stone Canyon dam, to store 7,000 acre-feet, is well under way. Numerous small reservoirs are planned to take the night flow and give local storage for use in daylight hours.

Moving a Standing 210-ft. Tree

By E. P. Stamm
Freshwater, Cal.

A 210-FT. tree with 10-ft. butt moved in its vertical position for a distance of 20 ft. was a recent accomplishment in the logging operations of the Pacific Lumber Co., at Freshwater, Cal. Two redwood trees which had been left standing for use as spar trees or gin poles were too far from the railroad track for effective use, but as it was impracticable to move the railroad it was decided to move one of the trees. This tree was originally 260 ft. high, but had been cut to 240 ft. by a "high climber" who ascended by means of spurs and a belt around the tree. At 240 ft. the trunk was 34 in. in diameter, and a pulley was attached for a ½-in. cable from the donkey engine.

When it was decided to move the tree, the climber



REDWOOD TREE 210 FT. HIGH MOVED 20 FT. (ARROW INDICATES STUMP). RIGHT-HAND VIEW SHOWS TREE GUYED FOR USE AS GIN POLE DERRICK

ascended in a chair hoisted by the cable and cut off a 30-ft. log. This left a 210-ft. trunk 38 in. in diameter at the top and 10 ft. at the bottom, containing 63,000 board feet by the Spaulding scale, which, at 10 lb. per foot weighed about 315 tons. In addition there was the weight of about 1,500 ft. of guy lines, six 1¼-in. wire cables being attached at 10 ft. below the top and secured to large stumps.

The butt of the tree was then sawed from the same side half through by two cuts, one 12 in. above the other, and the intervening block was blown out. Six vertical holes were then drilled at the center of the butt and fired one at a time until the half stump directly under the cut had been blown loose and removed. Four 30-in. peeled fir logs 25 ft. long were placed parallel and on a 2 per cent grade, with their ends in the undercut of the tree, forming skids on which the tree was moved. The rear guy lines were slacked 2 ft. and the front lines drawn taut, pulling the tree forward to facilitate sawing the trunk free from its stump. The remaining half of the trunk was then sawed through at the elevation of the skids. A holdback line or cable was placed around the bottom of the trunk and made fast to a stump, allowing 4 ft. of slack.

For moving the tree, the rear guys were slacked 4 ft., the front lines were made taut, and with a two-block purchase and a 1-in. wire cable the donkey engine pulled the bottom of the tree 4 ft. ahead on its skids until the ground holdback line was taut. The rear guys and holdback line were again slacked 4 ft., the front guys made taut so as to lean the top ahead 4 ft., and the bottom again pulled 4 ft. forward. These operations were repeated until the tree was adjacent to its new base or seat, which consisted of four 3-ft. redwood logs, 25 ft. long, laid parallel in an earth pit 3 ft. deep.

The two center skids were now chopped off, leaving the tree to move the last 10 ft. over two skids, which were then blasted to splinters so that the tree settled down on its seat, squashing the remaining part of the skids. When all guy lines were made taut by a block purchase with the engine, the tree was ready to receive its buckling guy wires, attached two-thirds of the way up the trunk to prevent it from buckling under excessive strains. A 36-in. bull block was attached at the top of the tree, two loading blocks were placed on two of the buckling guys and with lines threaded through the blocks the tree was ready to do its work as a high lead pole (or gin pole) for pulling in large logs and lifting them bodily on the flat cars to be transported.

Transport Ministry to Issue Regulations for London Traffic Control

(London Correspondence)

REGULATIONS proposed by London members of Parliament to deal with some of the city's traffic problems will, it is understood, be issued by the Ministry of Transport for voluntary adoption. The proposals made by these members have the approval of the Ministry of Transport and a number of local authorities, and legislation is really necessary before they can be put into operation. At the present late stage of the Parliamentary session, however, the government is not likely to push through a bill. It is believed that if the regulations are published with the approval of the Ministry, the Home Office and the majority of the local authorities they will hold good though, of course, they would in these circumstances not be compulsory.

The scheme proposed by the investigating committee includes regulations affecting vehicles waiting in streets, broken down vehicles, vehicles in an unsound condition and likely to break down, unattended vehicles, vehicles used for advertisement purposes, unhired cabs elsewhere in a thoroughfare than on a cab rank, cab ranks, and ranks and stopping places of omnibuses and other vehicles plying for public hire.

If the original scheme goes through Parliament in the form of a bill the Minister of Transport will be empowered to set out:

1. Thoroughfares which are not used by traffic or vehicles of any specified class or classes, either generally or at stated times.

2. Routes to be adhered to by all or any specified class or classes of vehicles or traffic between any stated points.

3. Speed of all of any class or classes of vehicles and the relative highway positions of traffic of varying speeds or types.

4. Precedence to be observed between vehicles proceeding in the same direction, in opposite directions or in crossing.

5. Places where and the conditions under which vehicles may turn in order to proceed in the opposite direction.

6. Conditions subject to which cattle, horses, sheep or other animals may be driven or led.

7. Conditions subject to which articles of unusual weight or dimensions may be carried by road, loaded or unloaded.

8. Conditions subject to which sanitary vehicles or vehicles delivering freight or merchandise of any special class or classes may stand in thoroughfares.

9. Conditions subject to which house and street refuse may be collected.

10. Traffic notices to be exhibited and the form and character of such notices.

By-laws are also proposed which will deal with obstructions to traffic. These include marking and lighting of bridges, lighting and guarding of street works, provision of sufficient head room in new bridges and the adequate lighting of structures with insufficient head room, the erection or placing of any works or objects likely to cause an impediment to the free circulation of traffic, queues of persons waiting for public vehicles or admission to places of entertainment.

The penalties suggested for the infringement of any fixed regulations are: First offense, a fine not exceeding £20; second or subsequent offense, a fine not exceeding £50. The continuance of an offense, after a conviction, would render the offender liable to a fine of £5 per day.

Concrete Chuting Plant for Dam Laid Out in Miniature

Swiss Dam Site, Towers, Chutes and Cables Reproduced to Scale by American Manufacturer to Insure Successful Operation

By C. W. Garrison
The Lakewood Engineering Co., Cleveland, O.

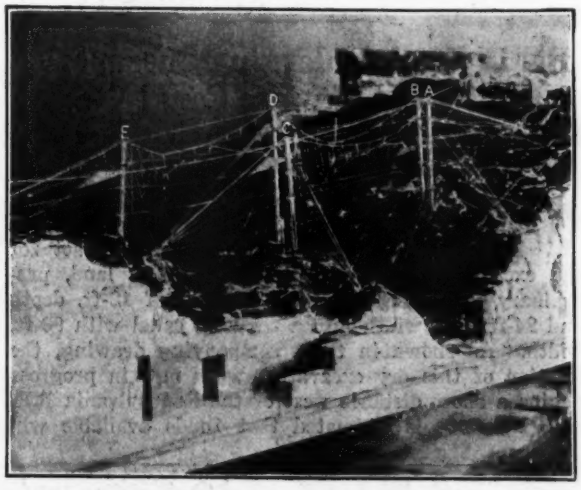
About April 1 our company received an order for a complete mixing and chuting plant for the construction of the Barrage de Barberine, a hydro-electric development in Switzerland. This dam, very similar to the Roosevelt Dam, will be about 875 ft. long, 215 ft. high, 17 ft. at the top and 200 ft. at the widest part of the base. It will contain about 375,000 cu.yd. of concrete. It will take about three years to complete the work because of the short season in which construction can be carried on. Layouts of the plant had to be made for various heights, as the work progressed.

In selling American machinery in foreign countries, it is necessary to "sell" American methods as well. Obviously, it would be ridiculous to suppose that people having no experience whatever with chuting plants, would be able to use the equipment unless complete instructions were provided. Accordingly, when the order was received, our first thought was, as to whether or not the plant, as laid out, would function properly. We wanted to be sure that nothing had been overlooked—that the plant layout was perfect and the various units of equipment selected correctly.

The preliminary layout, from which the equipment had been ordered, had been made before complete details were available. There was a chance that some unforeseen difficulty had arisen that would necessitate a rearrangement of the plant.

So, before attempting to fill the order, our engineering department was asked to check the plant layout and make up complete instructions for its erection and operation. The work had scarcely been started when it was discovered that a cableway for handling plums would interfere with the tower guy lines. This cableway with one end anchored and the other end attached to a movable tower, required 70 ft. vertical clearance, with 40 to 50 ft. horizontal clearance. Naturally, some arrangement of the guy lines, other than standard practice, would have to be evolved to permit the operation of the cableway.

After several attempts on the draughting board, it



MODEL OF CHUTING PLANT FOR SWITZERLAND DAM

was decided that the only way to solve the problem successfully was to build an exact model of the dam site and of the dam and erect the plant to scale.

Accordingly, the contour of the ground was reproduced in clay, following exactly the contour map which, fortunately, had been sent to us. The towers, guy lines, cables and chutes were all built to scale, in the exact positions they would occupy. The troublesome, but necessary, cableway was represented by a heavy white cord. Because accuracy was so essential, the construction of the model was necessarily slow work. In fact, two men spent practically two weeks on this part of the work.

The tedious work of making the model was, however, rewarded by the comparative ease with which the problem was solved. The required clearance for the cableway was apparent at a glance. Guy lines could be located with the certain knowledge that they would not interfere. Many guy lines had to be omitted because the wide valley upstream made it practically impossible to guy on that side without interfering with the cableway. This made it necessary to jack brace the towers and use double instead of single guy lines.

After the complete plant had been satisfactorily arranged, drawing were made to show the work at various levels, with the corresponding arrangement of every detail of the plant. These drawings, supplemented by detailed typewritten instructions, and photographs of the model, made it comparatively easy to understand just how the equipment should be used.

Every precaution was taken to explain clearly even the smallest details. In fact, as the equipment was

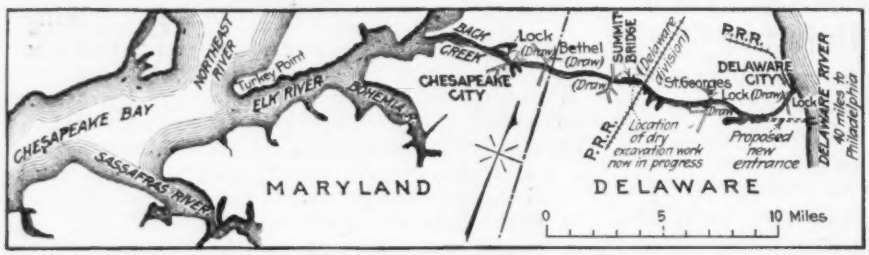
crated each piece and each crate was marked so that by referring to the instructions the plant could be unpacked as it was needed.

The mixing plant, of three 1-yd. mixers, will be located at towers *A* and *B*, shown in the accompanying photograph. *D* is a re-elevating tower, from which the concrete is carried to the tower *E*, where it is again re-elevated and chuted to place. The tower *C* carries the load line for the chute from the tower *A*, and is tied in with the tower *D* to secure maximum strength. Towers *A* and *B* will be 240 ft. high; *C*, 195 ft.; *D*, 240 ft.; and *E*, 120 ft. All towers are of steel. They are all located on the downstream side. The chuting plant is a combination of continuous line and counterweight chutes.

Begin Work Enlarging Chesapeake and Delaware Canal

Involves 675,000 Yards of Dry Excavation as First Construction in Building the Authorized Sea-Level Route

WORK OF ENLARGING the old Chesapeake and Delaware Canal has started under contract for the excavation of 675,000 cu.yd. of high land, preliminary to making the old lock canal of 12-ft. depth and 24-ft. lock width into a sea-level canal with 90-ft. width. As shown in the accompanying drawing, the location of this dry excavation work now in progress begins a short distance west of the Pennsylvania R.R. bridge and it is estimated that funds available will carry the work almost to Summit bridge, a little short of a mile distant. By the time work on the present contract nears completion Congress may appropriate sufficient money to proceed with the entire project, involving 6,000,000 cu.yd. of dry excavation and 10,000,000 cu.yd. of dredging.



SEA-LEVEL CANAL TO FOLLOW OLD ROUTE—FIRST WORK IN PROGRESS

The new waterway is to be known officially as the "Inland Waterway from Delaware River to Chesapeake Bay, Delaware and Maryland," and will have the same location as the old Delaware and Chesapeake lock canal built in 1824-29. Locks constructed in 1850 with a width of 24 ft. and a length of 220 ft. remain to the present time as a check to navigation. The present canal has three locks, with the summit level 15 ft. above mean low tide. The mean ranges of tide at Delaware City on the east end of the canal and at Chesapeake City on the west end are respectively 6 ft. and 2 ft. To supplement the supply of water in the summit level furnished by several streams flowing into it, a pumping plant was established at Chesapeake City lifting the water from Back Creek. No records can be found of the original equipment, but when the locks were enlarged about 1850 a waterwheel 34 ft. in diameter, with helicoidal buckets, driven by two walking-beam engines was installed. The wheel, capable of lifting and discharging 20,000 gal. per min., is still performing and according to observers, judging from its appearance, will be able to continue until the canal is lowered to tide level and there is no longer any use for it.

Decision to establish a sea-level canal in the same location as the old canal followed consideration of the subject dating from 1871, when a movement was launched for a ship canal across the peninsula. Subsequently a company was chartered to dig such a canal from the Sassafras River on the Chesapeake side to the Appoquinimink River on the Delaware side, but work never progressed beyond the project stage. In 1894, Major W. P. Craighill, afterward brigadier-general and chief of engineers, submitted a report upon the survey of seven different routes, not including the existing canal. In 1907 a report was submitted upon two routes, the Sassafras River and the existing canal, by a commission consisting of General Felix Agnus, Major C. A. F. Flagler, Corps of Engineers, U. S. Army, and F. T. Chambers, civil engineer, U. S. Navy. These reports were reviewed and further studies made by a special board of engineer officers in 1911-13 whose reports recommended the route of the existing canal.

Congress adopted the recommended project by an appropriation of $3,000,000 in the River and Harbor Act of March 2, 1919. This appropriation provided primarily for the purchase of the canal company's property at the agreed price of $2,514,289.70. Condemnation proceedings were instituted to clear title, other legal and preliminary proceedings were completed and the United States took possession of the canal and appurtenances Aug. 13, 1919. The first act of the Government upon taking charge was to abolish tolls, making the canal a free waterway. The adopted project is for a lockless, tide level canal 12 ft. deep and 90 ft. wide on the bottom, estimated to cost $12,000,000.

The plan of improvement includes a new entrance to the canal at Reedy Point on the Delaware River below Fort Du Pont, the new line joining the present line of the canal about 3 miles westward of the present entrance at Delaware City, north of Fort Du Pont. It is proposed, however, to improve also the present line of the canal from the forking point to Delaware City, to a depth of 12 ft. upon its present bottom width of 36 to 40 ft. for the use of barges bound to and from the upper Delaware River. The new entrance is intended for vessels bound seaward and for the ship canal when the waterway is so enlarged, following the completion of the present improvement.

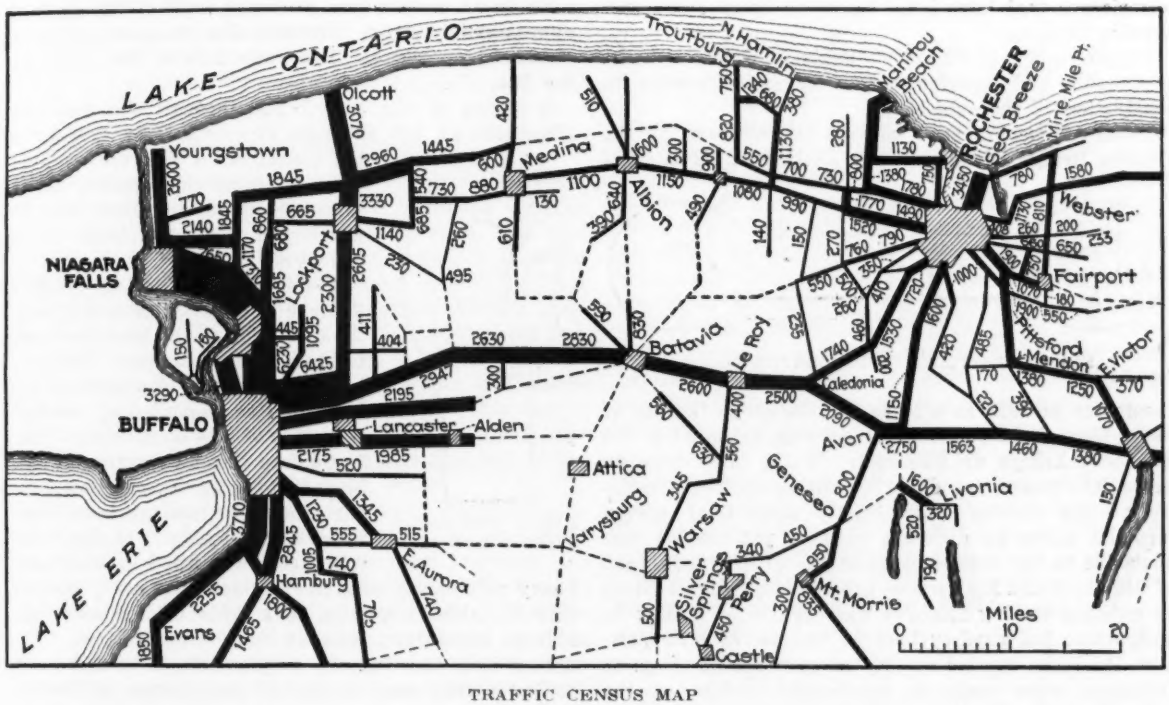
The adopted project provides that traffic through the canal shall not be interrupted during the work of improvement and therefore the plan of improvement had to be arranged to conform to this condition. The program of operation proposes to start with the construction of the six highway bridges to replace the antiquated, inadequate existing structures and at the

same time remove the overburden of dry excavation above the level of the present tow path, elevation 18 ft. above the datum (mean low water at Sandy Hook); then to deepen the summit level 10 ft. to the level of the section between Delaware City and St. Georges or if funds are available to the full depth of 12 ft. below datum; then to remove lock at St. Georges and lower sill of Chesapeake City lock 10 ft., producing one level from end to end of canal. The section between Delaware City and St. Georges will then be deepened to 12 ft. below datum and both Delaware City and Chesapeake City locks removed, thereby obtaining the tide level canal with unobstructed navigation. Finally excavation would be carried out along new line from Delaware River to junction with present canal.

Traffic Census Map for New York

THE New York State Highway Commission has just completed a traffic census map which shows graphically the maximum traffic over state highways for a period of 12 hr. during the month of August, 1920. The map, of which a portion is reproduced herewith, is drawn to a scale of 10 miles to the inch. The width of each road as shown on the map is made proportional to the observed traffic which it carried, the traffic scale being 20,000 vehicles per inch of width. In addition, the number of vehicles on each stretch of highway during the 12-hr. period is indicated by numerals.

The highway traffic map was originated by Charles M. Edwards, division engineer at Rochester, N. Y., for the New York State Highway Commission. The data for



TRAFFIC CENSUS MAP

Due to the necessity for curtailment of all government expenditures, the River and Harbor Acts of June 5, 1920, and March 1, 1921, did not carry any appropriation for the canal. With the balance of appropriation of 1919 left after the purchase of the canal, some additional land and expenditures for studies and surveys, excavation of the high land to the amount of 675,000 cu.yd. has been started under a contract with W. H. Gahagan Co. of Brooklyn, N. Y., at a unit price of 37c. This work is on the north bank of the canal and begins a short distance west of the bridge of the Delaware Division, Pennsylvania Railroad, at the eastern foot of ridge forming the back-bone of the Delaware Peninsula and it is estimated that the funds available will permit the extension of the work almost to Summit Bridge, a distance a little short of a mile. It is planned to confine the work of dry excavation to the north side of the canal as far as possible, as that side gives a slight advantage in the amount of excavation and also in order that the slopes on the south bank of the canal now well covered with trees and bushes, may be left undisturbed.

the map were collected during the administration of Frederick Stuart Greene, state highway commissioner. The traffic shown on the state highways, according to Mr. Greene, is the normal summer traffic, except possibly for a road between Albany and Saratoga, where the traffic is greater during the races.

Proposes Testing Rails Head Down

A recent suggestion by M. H. Wickhorst, engineer of tests for the Rail Committee of the American Railway Engineering Association, for better co-ordination of rail tests and service is that bend tests (drop or press) of rail samples be made with the rail head in tension. This position, he claims, would give a ductility closely correlated with the condition of the metal in the interior of the rail head, which in turn is believed to be in close correspondence with the liability of the rail to fail in the track. He claims that the drop test carried out with head in tension covers all the requirements of a chemical segregation test and at the same time is capable of revealing any fissured or shattered condition of the rail-head metal.

A Study of Stresses in Eyebar Heads

Past Practice in Proportioning Heads—Conclusions from Tests—Excessive Stretch—Permanent Set in Budapest Suspension Bridge Chains—Analysis Reveals High Stresses—Influence of Pin Diameter

By Josef Beke
Budapest, Hungary

EYEBARS are commonly proportioned by empirical rules which have not been checked by stress calculations so far as I know. It is obvious that the stress conditions in eyebars are much too complex for precise calculation, and for this reason dependable rules of design can hardly be derived by pure theory. But approximate analysis based on simplified assumptions is justified, to explain the results of tests and certain experiences that have been had with large chain suspension bridges.

Before entering into such analysis I will cite the test results and experiences that led me to further investigation of the subject.

Tests of eyebars were considered necessary by the Danube Bridge Division of the Hungarian Ministry of

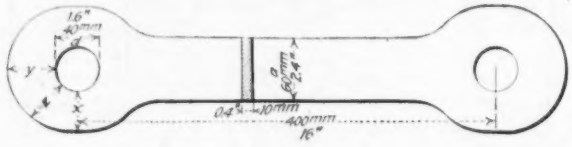


FIG. 1. TESTPIECE FOR DIOSGYOR TESTS

Commerce in 1898 as a basis for the proportioning of the eyebar chain members to be used in building the Elizabeth bridge at Budapest. While there was no immediate reason for doubting the approximate validity of the various (not greatly dissimilar) design formulas given by different authors, yet caution was advisable as the bridge in question, with a main span of 943 ft., would far surpass prior chain bridges. Since no existing testing machine was capable of pulling to destruction full-sized eyebars of the size here in question, the tests, carried out in the government shops at Diósgyör, were made on small-scale models, of the form shown in Fig. 1.

Hungarian Tests of Model Eyebars

All test bars were cut from the same plate, with a view to eliminating the influence of possible variation in the material. Four bars had circular heads, with width of metal ($x = y$) of 0.6 to 0.63 times width of bar; the other 37 eyebars had an elongated head like that in the sketch, Fig. 1. The latter shape had been used for the chain bars of the old Budapest suspension bridge, built in 1849 by W. Tierney Clark, and it was intended to use the same shape for the bars of the Elizabeth bridge. In these elongated heads the side ratio (ratio of x to the width of body of bar) ranged from 0.5 to 0.63, and the back ratio (ratio of y to width of body of bar) ranged from 0.63 to 0.75.

As in all similar tests, the object of the test was to determine such dimensions as would make the head stronger than the body of the bar. It may be recalled that Theodore Cooper's well-known specifications for American bridges require that rupture shall occur in the body of the bar, but beyond this leave the detailing of the head to the manufacturer.

The main results of the tests may be stated as follows:

1—When the back ratio was 0.75, the side ratio could be made as little as 0.50 without causing the bar to break in the head. With side ratio greater than 0.50, the back ratio could be made less than 0.75; for example, side 0.55, back 0.70; and side, 0.63, back 0.67.

2—In all cases where head and body of bar were of approximately equal strength, the diagonal width z, measured on the 45° line, was 0.66 of the width of the bar.

3—None of the bars broke through the back (at dimension y), but all broke at x or z. Fig. 2 sketches the character of fracture and the very extensive deformation of an originally circular eyebar head in which the side and back ratios were 0.63.

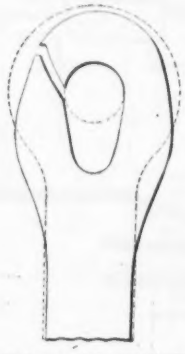


FIG. 2. FRACTURE ON DIAGONAL

4—In every bar tested, whether it broke in the body or in the head, the distortion of the head was very marked. When the side ratio was less than 0.57, the elongation of the head was accompanied by marked reduction of area at the sides. Fig. 3 sketches the deformation of two bars that broke in the body, the bars therefore meeting the Cooper requirement. Bar I (side ratio 0.50, back ratio 0.75) shows a very heavy reduction of area at the side of the head, whereas Bar II (side ratio 0.59, back ratio 0.75) shows only a large elongation, without marked contraction. The dotted line, showing the original shape of the head, indicates that even in Bar II the stretch of the eye was so great that the pin hole elongated nearly 40 per cent. It developed from these results that the condition heretofore considered governing (i.e., rupture to occur in the head) can be met by making the side ratio not less than 0.57, and the back ratio such as to give a diagonal ratio of 0.66. Correspondingly, and in fair agreement with existing rules for proportioning eyebar heads, it was decided to adopt a pin diameter two-thirds of the bar width, side ratio

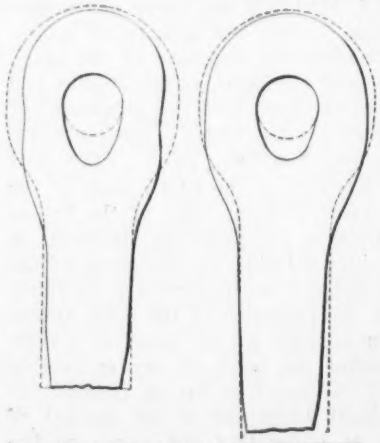


FIG. 3. TWO TYPICAL DISTORTION SKETCHES
(Both bars broke in body)

of the head 0.58, back ratio 0.75, and therefore diagonal ratio 0.69. The same formulas were used sixteen years later in the reconstruction of the old Budapest suspension bridge (1914-15), while the original chains of this bridge had pin-diameter ratio 0.44, side ratio 0.53, back ratio 0.68, and diagonal ratio 0.66.

Various authorities have recommended decidedly divergent proportions. Winkler specifies $x = \frac{1}{2}a + \frac{1}{4}d$ and $y = \frac{1}{2}a + \frac{3}{4}d$, which, in the case of a pin diameter d two-thirds the bar width a, gives side ratio 0.72 and back ratio 0.94. Berkley gives, for $d = 0.75a$, the side ratio 0.62 and back ratio 1.0. In America, where circular eyebar heads are in general use, the bridge shops use ratios of 0.665 to 0.75, regardless of pin diameter. Clark's proportions as exhibited in the old Budapest bridge chains have already been noted; values lower than those of the tests I have quoted are also given by Gerber, who makes the side ratio 0.55 and the back ratio 0.75. Summarizing, practice hitherto has used side ratios of 0.53 to 0.75, and back ratios of 0.67 to 1.00.

Stretch of Eyebar Heads

First mention of the very great stretch of eyebar heads was made by Cooper in his paper on tests of eyebars for the first Quebec bridge (*Trans.*, Am. Soc. C. E., 1906, 411). In these tests, with pin diameter 0.8 of the bar width, and head metal ratios of 0.72 to 0.81, permanent stretch in the heads was noted at loads as low as 12,000 lb. per sq.in. in the body of the bar, and at loads of 24,000 lb. per sq.in. this stretch amounted to $\frac{1}{16}$ to $\frac{1}{4}$ in. In the discussion of Cooper's paper, Prof. Mansfield Merriman explained this stretch by the unfavorable distribution of the bearing of head on pin, this pressure being greatest in the axis of the bar and having only small lateral extent.

Though it is obviously true that the maximum pressure is higher than the average (or projected) pressure, yet neither theory nor tests warrant the assumption that, with pin diameter two-thirds the bar width as usual, the bearing pressure exceeds the allowable limit. Even if the bearing pressure becomes excessive, it is not easy to see how it could result in anything more than local crushing. In fact, Prof. Merriman himself did not propose an increase of pin diameter, though this would suffice to reduce the bearing pressure, but he recommended the use of oval pin holes for better distribution of pressure along the sides of the pin.

That change of *maximum* bearing pressure without change of pressure distribution has little effect on the stresses in the eyebar head was shown by Cooper's tests on the influence of pin clearance, as well as by our own tests. In one series the pin was 3 mm. smaller than the pin hole (so as to produce high local bearing pressure), but the test results were not affected; the heads stretched about as much as but not more than in the other tests, in which the pin clearance was only $\frac{1}{2}$ to $\frac{3}{4}$ mm. and therefore the maximum bearing pressure unquestionably much lower.

Nevertheless it seems that some American engineers consider increase of pin diameter to be a means of preventing excessive stretch of the head. Dircksen quotes the practice of the American Bridge Co. as involving pin diameter ratios from 0.9 to 1.3 (*Z. d. Ver. deutscher Ing.*, 1908, 368). Lindenthal recommends pin diameter equal to width of bar. In 1913, preparatory to the construction of the great bridges of the New York Connecting Ry., Lindenthal made large-scale tensile tests on bars of these proportions (reported by J. Melan in *Eisenbau*, 1914, 342). However, those large-scale tests do not supply confirmation of the view referred to. Although the pin diameter was equal to the bar width, and the head was so proportioned that the bars broke in the body, yet the head stretched so much that the 16-in. pin holes elongated by 97 mm. (maximum 122 mm., in a single case even 171 mm.). This very considerable elongation (average 24 per cent), occurring in a material of 64,000 to 71,000 ultimate, with 22.8 per cent elongation on 10-ft. length, demonstrates that in spite of the large pin diameter the head of the bar was subjected to extremely high stresses.

Elongated Pin Holes at Budapest

In the course of the discussion of the Cooper paper already mentioned, A. J. Himes asserted that stretch of eyebar heads is not observed in actual bridges. The Budapest suspension bridges show the contrary, as will be cited; doubtless other chain bridges would also reveal stretched heads.

When the chains of the old Budapest bridge were taken down, in 1914, we observed in *all* pin holes (original diameter $4\frac{1}{2}$ in., or 0.44 times width of bar) a longitudinal stretch of 2 to 3 mm., although the bar stress did not exceed 16,000 lb. per square inch.

It seemed reasonable, therefore, to anticipate a decided stretch of the chains in the new Elizabeth bridge. On this account, not only was each link shortened by the amount of the elastic stretch due to the dead weight of the bridge, but in addition it was shortened $\frac{1}{2}$ mm. as allowance for its coming to bearing against the pins. After completion of the bridge the sag of the chain was several centimeters greater than the designed amount; the difference is in part at least chargeable to stretch of the heads.

From the preceding it may be concluded that it is worth while to attempt an analysis of the stresses in eyebar heads.

Stress Analysis of Eyebar Heads

In a circular eyebar head, let it be assumed that all stresses remain below the proportional limit, that radial plane sections remain plane, and that the stress in the body of the bar is uniformly distributed. Let it also be assumed that the bearing pressures between pin and hole are radial and vary as the cosine of the arc between the point considered and the axis of the bar. With this assumption, integrating the bearing pressures and equating the total axial component to the load on the bar, P, we find that the bearing pressure at the back of the pin hole is

$$s = \frac{4P}{\pi d} \qquad (1)$$

or 1.273 times the average pressure on the projected diameter. Further, with pin diameter two-thirds the bar width, the maximum bearing pressure is 1.905 times the unit tension in the bar, or well under twice the tension, a safe limit of permissible bearing pressure.

The transfer of stress from bar to head is assumed to take place on the middle line of the head metal, as sketched in Fig. 4. The influence of the fillets Q is neglected. The amount of stress applied to an ele-

mentary arc of the head circle, with radius r, is $\frac{P \cos V' dV'}{2 \sin W}$. The eyebar head is to be investigated as a ring loaded on one side with the bar stress and on the other side with the bearing pressures transmitted from the pin.

To determine the stresses in this ring we will assume it severed by a slot along the center line of the bar, on the side nearest the bar. The right-hand side of this slot, $D'E'$, will be taken as fixed in position, while the left-hand side DE is free to move during the distortion of the ring under its load. Then, since the slot in reality does not exist, and the two surfaces DE and $D'E'$ remain in unchanged relation, such internal forces must be applied at the faces of the imaginary slot as will restore the face DE to its initial position. The forces required for this purpose are a transverse force X_o and a moment M_o, acting at the pin center O, which for this purpose is taken to be attached by a rigid arm to the face DE. On account of the symmetry of the arrangement, no force longitudinal to the bar can act at the faces of the slot.

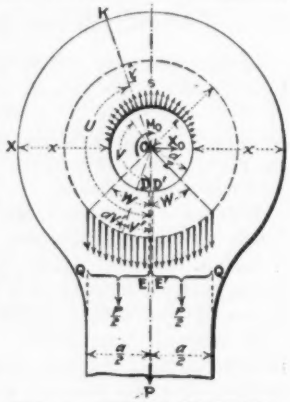


FIG. 4. STRESS DISTRIBUTION ASSUMED FOR ANALYSIS

Mathematical conditions sufficient to determine the unknowns X_o and M_o are furnished by the principles of elastic theory concerning deformation, which must be so applied that the slot face DE retains its original position when all the forces mentioned are acting. Omitting the influence of temperature and shear, the theory of least work may be used to give the following equations:

$$\frac{r}{EF}\int n \frac{\delta n}{\delta M_o} dU + \frac{r}{EZ}\int M \frac{\delta M}{\delta M_o} = 0$$

$$\frac{r}{EF}\int n \frac{\delta n}{\delta X_o} dU + \frac{r}{EZ}\int M \frac{\delta M}{\delta X_o} = 0 \qquad (2)$$

in which n and Z denote the values,

$$n = N - \frac{M}{r} \text{ and } Z = r\int \frac{v^2}{r - v} dF \qquad (3)$$

while r is the radius of the center line of the head, N is the normal stress on a cross-section K of the ring, M is the bending moment on the same cross-section referred to its gravity axis, F is the area of ring cross-section, v is the distance of any elementary part of the cross-section from its gravity axis, U is the angular distance of this cross-section from the slot face DE, and E is the modulus of elasticity of the material. The normal stress N is taken as positive when tension; the moment M is positive when clockwise, and v is positive when measured toward the center. The thickness of the eyebar head being made unity, the area F is numerically equal to x, the width of head metal. Equations (2) are to be extended over the whole ring, and the expression for Z over the entire area of cross-section. The expressions for the normal stress and moment must be written separately for each of the loading segments of the ring. When these values and their derivatives with respect to M_o and X_o are substituted in equations (2), the integrations carried out for each segment, and the partial results added so as to embrace the entire ring, the resulting equations when solved for M_o and X_o yield the following:

$$M_o = Pr \frac{\frac{1}{F}\left(\frac{W}{4 \sin W} - \frac{\cos W}{4} + \frac{\pi - W}{2} \sin W\right) - \frac{r^2}{Z}\left(\frac{W}{4 \sin W} + \frac{3 \cos W}{4} - \frac{\pi - W}{2} \sin W + \frac{4}{\pi}\right)}{2\pi\left(\frac{1}{F} + \frac{r^2}{Z}\right)}$$

$$= B(Pr) \qquad (4)$$

$$X_o = P \frac{1}{2\pi}\left(\tfrac{1}{2} - \frac{\sin^3 W}{3}\right) = C(P) \qquad (5)$$

The coefficients B and C in these formulas involve nothing but dimensions of the eyebar. The value Z may be computed by integrating after substituting $u = r - v$, or

$$Z = \int_{-\frac{1}{2}x}^{+\frac{1}{2}x} \frac{rv^2}{r - v} dv = -r\int_{r+\frac{1}{2}x}^{r-\frac{1}{2}x} \frac{(r-u)^2}{u} du$$

$$= r^2\left(r \log_e \frac{r + \frac{1}{2}x}{r - \frac{1}{2}x} - x\right) \qquad (6)$$

Having determined the statically indeterminate stresses X_o and M_o at the imaginary slot, the stresses N and M at any point of the ring can now be found. For the lower quadrant the values are,

$$N_1 = P(\tfrac{1}{2} \sin U + C \cos U)$$
$$M_1 = Pr(\tfrac{1}{2} \sin U + C \cos U + B - \tfrac{1}{4} \sin W) \qquad (7)$$

and for the upper quadrant ($\frac{1}{2}\pi < U < \pi$),

$$N_2 = P(\sin U - \frac{U \sin U}{\pi} - \frac{\cos U}{\pi} + C \cos U)$$

$$M_2 = Pr(\sin U - \frac{U \sin U}{\pi} - \frac{\cos U}{\pi} + C \cos U + B - \tfrac{1}{4} \sin W) \qquad (8)$$

while for all cross-sections

$$n = P(\tfrac{1}{4} \sin W - B) \qquad (9)$$

The maximum tension in any cross-section being expressed by

$$S = \frac{n}{F} \pm \frac{Mx}{2Z} \frac{r}{r \mp \frac{1}{2}x} \qquad (10)$$

the stress maximum must be simultaneous with maximum M, since n is independent of the location of the section. From equations (7) it will be seen that M reaches a maximum in the lower quadrant when $\tan U = \frac{1}{2C}$, which in our case is very near $U = \frac{1}{2}\pi$, so that we may assume that the maximum stress occurs at the horizontal section X in Fig. 4, where

$$M_x = Pr(\tfrac{1}{2} + B - \tfrac{1}{4} \sin W) \qquad (11)$$

and the maximum tension occurs at the inner edge. In the second quadrant the maximum stress occurs at $U = \pi$, where the greatest tension is at the *outer* edge of the ring; the moment here is

$$M_y = -Pr\left(\frac{1}{4} \sin W + C - B - \frac{1}{\pi}\right) \qquad (12)$$

At the diagonal cross-section Z (see Fig. 6) the moment is,

$$M_z = Pr\left(\frac{\frac{1}{4}+\frac{1}{\pi}-C}{r/2}+B-\tfrac{1}{2}\sin W\right) \quad (13)$$

Applying the preceding formulas to a circular eyebar head with the fairly common proportions of pin hole two-thirds the bar width, and metal width x three-fourths the bar width (thus giving 50 per cent increase of section through the pin hole), we have the following extreme-fiber stresses in terms of the stress T in the body of the bar,

$$S_x = 2.57\,T$$
$$S_z = 0.79\,T$$
$$S_y = 0.76\,T$$

and a compressive stress of 0.2 T at the outer edge of cross-section X. Cooper computed, for the simplifying assumption that the bearing pressure is concentrated at the back of the pin hole, and neglecting the curvature of the bar, that the tension at the inner edge of section X is 2.95 T, while the compression at the outer edge is 1.61 T.

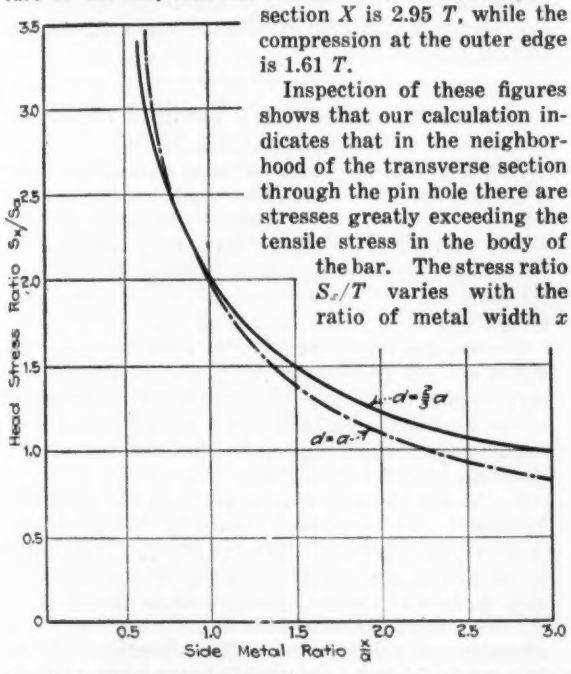


FIG. 5. HEAD-STRESS RATIO FOR VARYING METAL WIDTH

Inspection of these figures shows that our calculation indicates that in the neighborhood of the transverse section through the pin hole there are stresses greatly exceeding the tensile stress in the body of the bar. The stress ratio S_x/T varies with the ratio of metal width x to the bar width a. Its manner of variation is diagrammed in Fig. 5 for two sizes of pin hole, pin diameter equal to bar width and equal to two-thirds of the bar width. The diagram shows that, as the metal-width ratio is increased, the stresses in the head decrease very rapidly at first, but later on more slowly, so that for pin hole equal to two-thirds the bar width the maximum tension in the eyebar head does not become as small as the tension in the body of the bar until the head metal width is increased to 2.9 times the bar width, a value out of the question for practice. On the other hand, if for practical reasons the metal width x be kept within the range of 75 to 100 per cent of the bar width (50 per cent to 100 per cent excess of metal through pin hole), the eyebar head would have to be thickened to 2.0 to 2.5 times the bar thickness in order to keep the head stresses down to the stress in the body of the bar.

With pin diameter equal to bar width (as used by Lindenthal), the stress in the head for the customary

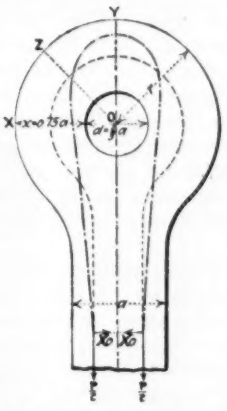


FIG. 6. LINE OF EQUIVALENT TENSION

dimensions is not decreased, but even a trifle increased. Not until the diameter of the head is made very large does increase of pin diameter have a favorable effect on the stress; for example, the maximum head stress becomes reduced to the amount of the stress in the body of the bar when the metal width-ratio is 2.28 as compared with 2.9 for pin diameter two-thirds the bar width.

This analytical result, that for the usual proportions of heads an increase in pin diameter means increase of stress in the head, justifies the opinions of those who, like Winkler, A. J. Du Bois, and others, make the width of head metal vary with the pin diameter. This had, in fact, been suggested by Charles Shaler Smith on the basis of his 1868 tests ("Proportions of Eyebars and Pins," *Transactions A. S. C. E.*, 1877, p. 263).

The formulas above derived make it possible to sketch the line of equivalent tension in any circular eyebar head, since the quantities M and N may be computed for various cross-sections and the distance of the line of tension from the center line of ring (M/N) thereby determined. In Fig. 6 the results are plotted, positive values being laid off inside the center line. The tension X_0 at the imaginary slot in Fig. 4 acts at a distance M_0/X_0 from the pin center.

High Stresses in Eyebar Heads

The results of these stress calculations tend to explain the previously observed stretch of eyebar heads, and also agree with the observation that stretch and fracture never develop in the cross-section Y at the back of the pin. Moreover, Cooper's remark that in the transverse cross-section X no stretch develops along the outer edge of the head, *and also no perceptible shortening*, corresponds quite well with the computed result that the compressive stress at this point is relatively small.

But the Diósgyör tests appear to be in contradiction with the results of calculation in one respect. At metal width $x = 0.6$ to $0.7\,a$, the test bars did not break in the head but in the body of the bar. Further, fractures in the head often occurred at the diagonal section Z, where, according to the calculation, much lower tension prevails than in the cross-section X. It is to be remembered, however, that the calculation is based on assumptions correct enough for service conditions, when the stresses remain within working limits, but no longer valid at stresses exceeding the yield-point. The drawings Figs. 2 and 3, as well as the statements concerning Dr. Lindenthal's tests, show clearly that bars which break in the body show almost as much stretch of the head as those which break in the head. With such extreme stretch of the head metal, and when the pin hole distorts so excessively, the distribution of bearing pressure at the pin surface can no longer follow the same law as at lower stages of stressing.

As the pin hole stretches and correspondingly a lateral contraction develops, the bearing pressure along

the haunches of the pin must increase, while that at the back of the pin hole must decrease. Such change in pressure distribution will—and application of the previously used method of analysis would readily show this—reduce S_x, while S_z will increase. Bearing this in mind it is possible to assume a pressure distribution (which, however, could occur only after great distortion) by which the observed fracture phenomena would be explained, and the apparent contradiction of computation and test thus removed.

However, for the purpose of proportioning eyebars, the stress conditions which immediately precede fracture and only occur after large distortion of the head are not particularly important. Though it may be considered reassuring that distortions exert a favorable influence on the stresses in the eyebar, so that even inadequately proportioned heads are safe against fracture by virtue of secondary actions occurring only after considerable distortion, yet the fundamental principles of sound engineering design do not sanction the practice of allowing excessive stresses in certain important structural elements, or that as a result of these excessive stresses permanent distortions should be allowed to occur even at working loads.

At the best we may allow in the eyebar head somewhat larger stresses than we use in the body of the bar, since test shows that this does not entail risk of fracture. But under no circumstances should these stresses be allowed to reach the yield point. With the customary values of stress T in the body of the bar, we should therefore limit the maximum stress in the head, S_x, to 1.8 T, to guard against permanent elongation. This limit in turn would, according to the values given by the curves in Fig. 5, give us a width of head metal $x = 1.15\,a$ to $1.2\,a$, for pin diameter $\frac{3}{4}\,a$ to a; and, on the other hand, if a metal width $x = 0.75\,a$ were adopted, the thickness of the head would require to be 1.4 times that of the body of the bar.

But it is not my intention to use the preceding stress analysis for deriving rules by which eyebar heads may be proportioned. The stress relations are so complicated that it is hardly feasible to appraise the influence of the various assumptions involved. For example, the oval form of head, customary in Europe, doubtless influences the stresses, in a manner hard to evaluate by analysis; probably it tends to reduce the stress at X and increase the stress at Y. Despite the difficulty of dealing with the question on a purely theoretical basis, however, the above-calculated results justify one important conclusion concerning eyebar heads: *With the customary proportions of heads, the stresses in the head are much larger than those in the body of the bar, and this unfavorable condition is not relieved by increasing the pin diameter.*

Further, the stress calculations suggest, in my opinion, the need of further tests to clear the question. Such tests should be caried out with accurate strain measurement.

Detailed study of the question is the more important as the eyebar problem affects a very important element of large bridges. Moreover, the results of a full investigation may influence the method of manufacturing eyebars. Cutting eyebars out of plates as wide as the head diameter, as was done in making the chain links for the Elizabeth bridge in Budapest, is too wasteful to be advantageous if very large heads are necessary in the absence of local reinforcement, as the above analytical results lead us to infer. In that event it would be necessary to resort to the method formerly used, and universally employed in America, namely, making the heads by upsetting and press-forging.

The procedure used in the present paper may be applied also for the analysis of eyebars used in machine construction. That the bar heads used in such service have not apparently given any trouble through excessive deformation may be ascribed to the fact that the heads of such bars are commonly reinforced by thickening, and that the stress in the body of the bar is usually far below the limit considered safe in bridge construction.

Large chain bridges are likely to be built in the near future only in America, where, moreover, eyebars are used in important service as the tension members of large truss bridges. For this reason the natural agencies for carrying out the suggested tests with a view to obtaining a final solution of the eyebar question, are the well-endowed and excellently equipped American testing laboratories.

Comment on London's Traffic Procedure

(*London Correspondence*)

ROAD USERS in London for some time have been urging a revision of the city's traffic by-laws and regulations. Despite the excellent control exerted by the police, the traffic in all the main thoroughfares is so congested that movement at any speed is quite out of the question. At present time all vehicles may use all streets.

The London omnibuses, for instance, on some routes utilize streets where other vehicles must draw into the curb to allow them to pass, and, on one or two bridges where the road is carried over a railway, an official of the omnibus company has to be stationed so as to allow only one bus over at a time.

In the list of powers to be given to the Ministry of Transport, the one which refers to relative highway positions of vehicles of different speeds is not believed to be practicable except on some of the widest and most modern of London streets, such as Kingsway. On the chief thoroughfares there is room for two streams of traffic, one proceeding in either direction. The only practicable method is to divert slower traffic to another street.

In the vicinity of some of the city's markets and elsewhere droves of cattle and sheep hold up traffic for five minutes or more. A remedy for this condition is long overdue.

In some of the city's busiest thoroughfares are situated the warehouses of the large dry-goods merchants, and here may be seen wagons and trucks standing all day loading and unloading huge packing cases, to the danger of traffic and pedestrians. This is especially the case near the river in the older sections of the city.

Coming down Ludgate Hill, one of the busiest city thoroughfares at 10 a.m., one may see refuse carts being loaded and confectioners' delivery vans being unloaded alongside on the curb. The dust carts are huge horse-drawn vehicles with open tops. The refuse is carried to the top of these vehicles in an open basket by a dustman and dumped anywhere and anyhow into the open top of the dust cart. At the same time trays of uncovered cakes are being unloaded and carried into a well-known restaurant.

What Men in Practice Say About Engineering Education

They Discuss Prof. Burr's Paper—Comparisons with Legal and Medical Professions Evoke Most Interest

BOTH agreement and disagreement with the contentions made by Prof. W. H. Burr in his recent address before the Society for the Promotion of Engineering Education (see *Engineering News-Record*, July 14, page 65) are found in the following discussions received in response to the editor's request for an expression of views. Both Messrs. Gustavas and Campbell differ in part from Professor Burr, while the other writers are in general agreement with him. Mr. Perry lays emphasis on the value of the extra-classroom activities, while Mr. Turner points out the need for courses of what he calls vocational type, which will supply the bulk of the workers in engineering.

The subject is far from being exhausted, and we urge those having views other than those here expressed to send them to us.—EDITOR.

BY F. LAVIS
Consulting Engineer, New York

In general the views of Professor Burr are very much in accord with those I expressed at the Conference on Commercial Engineering held at Washington in June, 1919, when I voiced a plea for the broader training of engineers for overseas service, but Prof. Burr has very much more ably presented the subject from the standpoint of the educator.

Too much emphasis cannot be placed on the fact that if engineers do not get the recognition from society that lawyers, doctors and other scientists do, it is because they are lacking in real education and an intelligent interest in business. I think there are enough engineers who have been so recognized to prove the truth of this.

Engineering education should of course aim first and foremost to give the student a thorough training in engineering principles and perhaps a vision of what he may attain in his profession. This latter I think is fairly well attained by those schools who get engineers of some standing in their own special line of work to give one or more lectures to the graduating class—not to teach them engineering—but to indicate to them what the practice of engineering is or may be in its higher aspects. Besides this purely technical training however, I feel very sure that engineers as a whole will never attain a high standing in the community until they are really educated and cultured men.

Some recent happenings in New York tend to show that some engineers also are woefully lacking in a true appreciation of such professional courtesy as would be instinctive in true gentlemen, and while it is true that mere book learning will not help this very much, I believe true education—as distinct from the acquisition of technical knowledge—would help quite a little.

In general I am only repeating what Prof. Burr has so well said, but I think the need of a broader culture and education for engineers in addition to the necessary technical training cannot be too strongly emphasized.

BY CHARLES W. GUSTAVUS
Mechanical Engineer, Detroit

It is incorrect to compare the engineering profession and the legal or medical profession, as engineering in its very best form does not measure up to medicine or surgery, never will and never can.

Before taking up the reasons for these statements, I wish to ask where Prof. Burr gets the idea, or at least gives that impression, that members of the medical and legal group are world-beaters. It cannot be proved that every graduate in either one of these branches rises to a pinnacle of success and blazes the way for the rest of the community.

The reason for not comparing medicine and engineering is that they are not near enough alike. Medicine, and surgery, if you please, deal entirely with the human element and that make-up of the individual known as sentiment. The patient, and ones near and dear to him, expect a learned and proficient man to handle the case, capable of performing the operation or the administration of drugs without any blunder. Society, to assure itself of this service, has set up rigid requirements in the way of reputation and license laws. It will not tolerate a person calling himself a doctor who had a chance to break into the medical game by sawing off a few arms or legs now and then to get some experience, and when able to wield a few knives dexterously, wants to hang out a shingle.

Engineering, on the other hand, deals with inanimate materials. No problem in the profession, even if it holds lives in the balance, depending upon its proper execution, is solved upon pure engineering principles alone. Years and years of past experience are brought into play, and form the true basis of the trust that the engineer places in the project before it is proceeded with. Any deviation from this rule calls for experimental work as a preliminary operation in the solution of the case. That is why we have men who, without a technical education, call themselves engineers, who can perform engineering work based upon their past experience. Their blunders do not hold life in the balance as in the medical profession, and society has not felt the need of laws to limit the practice of engineering to technical graduates. Of course, there are exceptions to this, such as bridge work, but from a theoretical standpoint and close analysis, even that exception vanishes. It is only cold-blooded commercialism that requires a technical man to design a bridge. To build a Quebec Bridge on past experience alone and push flat cars across loaded with granite blocks for a safety test is not considered good form. So why try to compare engineering and medicine.

Regarding the legal profession. I think Prof. Burr has lost sight of the fact that a lawyer is so educated that he can fit himself nicely into several other places than a law office and still garner some of the worldly goods and esteem of his fellow-men. And because he makes a good purchasing agent he does not disclaim his profession and act as if everything has gone to the bow-wows. He has sense enough to carry on and consider his law course an asset.

But far be it from me to knock the engineers. I want to see them get their just share of recognition, because I am one myself.

Improvement of Curriculum—I agree with Prof. Burr on some phases of his suggestion for improving the engineering curriculum. This can be done, not by giving more time as he suggests, but by stripping colleges and university courses of thesis work and such bunk as design courses in conveying machinery. Good old fundamental work in physics, mathematics and mechanics, along with some cultural subjects like economics, corporation finance and what else time permits, with perhaps an additional year, will give some real engineers who a little later can act as directors and still feel that an engineering education is worth while.

Up to the present time specialization, and fancy names invented by engineers themselves tending to bring it about, has caused a good deal of the difficulty. When we get rid of efficiency engineers, concrete engineers, industrial engineers and a thousand and one others, and realize that a man who knows his fundamental theory from A to Z can tackle any of these so-called branches, then we can talk about engineering as a profession.

The tendency is now for vocational ideas in engineering,

which must be stopped. Why let a student become an automotive engineer, when if he knew his beam theory or fundamental electricity as he should he would have courage to move about and find himself, instead of throwing up the sponge when he finds that he does not like the smell of gas and begins work in a bank. Then all graduates will have a good education to make them logical, clear and concise thinkers, which is all that is needed for leadership, plus a little pep.

As soon as engineering is put on a level where a technical course is recognized as a prime requisite, instead of a time-killer in work that can be just as well obtained in shop and practice before or after graduation, professional grade will be a possibility.

By J. P. H. Perry

Vice President, Turner Construction Co., New York

I am in such hearty accord with nearly everything that Prof. Burr has had to say that I would seem almost to be painting the lily if I attempted to discuss this admirable contribution at any length.

It seems to me that one of the very greatest things that a fellow gets out of a university education is the acquaintanceships that he forms and the learning how to meet men on a plane of equality. Entirely aside from the A, B, C's acquired by a student, the taking part in college affairs and the playing together with his fellows stands him in good stead throughout his life. The game of life is not all serious drudgery and it is common knowledge that often the man who played hard in college is a bigger success in after life than the brilliant student who never took his nose from off his text books.

Another point in favor of the college education preceding the technical course is the value of the friendships formed in after-life in lines other than engineering. A student at an "engineering school" makes his life-long friends among his competitors whereas an engineering student who had three years of college would make many strong friends who in their after-life could give him business in place of competing with him. It is this condition which undoubtedly helps doctors and lawyers to get many of the advantages which the engineering profession is supposed to envy them.

Prof. Burr's plea for a six-year course, half of broad college education and half hard technical study, it seems to me, would result in engineers having learned how to play and to mix with their fellows, which faculty, as a class today, they so sadly lack. It is right here that the college-trained man, including the lawyer and the doctor, is a different animal from the average graduate of an engineering "school."

Among the major qualities that seem to me to be responsible for the difference between success and failure among engineers is that of personality, which, regarded from the point of view under discussion, includes particularly breadth of interest, ability to play and an easy manner among men, combined with forcefulness and a knack of getting what one goes after. These talents can unquestionably be better cultivated at an institution where the college education is followed by a post-graduate technical course than at the average engineering school which concentrates on engineering training.

It seems to me that Prof. Burr has put his finger on the very heart of the reason back of the frequently heard complaint that engineers do not receive their just share of the world's rewards for their activities.

By J. L. Campbell

El Paso, Texas

Professor Burr lays down several allegations substantially at follows:

1. Professional education should rest on a prior general college education of cultural character.

2. Engineers and the profession of engineering do not have the recognition and standing accorded law and medicine because engineers do not have a general cultural college education.

3. Lawyers and doctors and the profession of law and medicine have the recognition and standing which engineers and engineering lack because lawyers and doctors have a general cultural college education.

It is generally (almost unanimously) acknowledged that a broad cultural college education is most desirable and should be acquired when practicable and that with it men can advance farther and attain greater success and eminence in any calling than without it.

But the allegation that engineers and engineering do not and that lawyers and doctors and law and medicine do have recognition and standing because the first have not and the second have broad cultural college education is found to be unproved by the facts.

The facts are not as alleged or implied. Not all engineers lack and not all lawyers and doctors have cultural education. The profession of law and medicine have never made a broad cultural college education a pre-requisite to the study of law and medicine and practice therein. The profession of the law is generally rated at the head of the learned callings, but the percentage of its members who have been admitted to the bar by passing the required examination after a brief law course or even only one or two years' reading of law in a lawyer firm office is surprisingly large.

I make the allegation that the members of the bar who have had a broad cultural college education are in the minority and that the percentage of cultured men in engineering is as large as it is in law or medicine.

By W. O. Hinkley

Stanley Mines, Idaho Springs, Colo.

I agree with Prof. Burr, in his article in the *News-Record* of July 14, that a broader education for engineers would help materially in bettering their professional status, and if as he suggests it would be possible to graduate men from a course of this length without increasing the average age of graduation then indeed there would be nothing against it.

I think, however, that there is another factor which is often overlooked, that is, that besides educating him we must also educate the public to a slightly different opinion of professional status.

I believe that, in spite of what the facts may be, a large part of the public regards a professional man as essentially a white-collar man, and this is largely true. The medical and legal professions are essentially of an office and laboratory nature. A large proportion of their contacts tend toward continual polish. Even their clients try to appear at their best to the doctors and lawyers.

The engineer, on the other hand, must spend a large share of his time on the job, on field work, in contact with an element where a white collar would be out of place. A considerable number of the people with whom he is thrown seem to make it a point to conceal any culture which they have. Bad English is the rule rather than the exception. These contacts are bound to leave their mark on any man no matter how careful he is or what his previous education may have been. The entire process is roughening rather than polishing or cultural. Then too, as has been mentioned in your columns, a large percentage of engineers are working for wages or a salary rather than a fee. This again classes them with the trades rather than the profession.

To secure full recognition of the engineer as a professional man the public must be educated away from these beliefs. Undoubtedly a broader general knowledge on the part of the engineer would tend a great deal to this education of the public.

I would like to suggest a few courses not strictly engineering in character which would be of great benefit to any prospective engineer; the average engineering student regards these courses with great dislike but in after life, feels their loss:

English, civics, economics and, in the West, Spanish.

A remark that is often made jokingly, "Don't let your studies interfere with your college education," is a very good one if not carried to extremes. Many engineers with

an excellent knowledge of the theory and practice of the work are seriously handicapped by an inability to mix, and college is the best place to acquire this knack.

In other words, a foundation, at least, in the business methods of the country, and, even better, of the civilized world, should be a part of the education of every engineer.

By D. L. Turner
Consulting Engineer, Transit Commission
New York

In diagnosing and so forcefully emphasizing the defects in engineering education, Prof. Burr has rendered a notable service.

His address should be read by every engineer who is really interested in the future of the engineering profession, or better still, some way should be found to bring Prof. Burr's ideas home to the boys in the public schools and in the preparatory schools, where they are beginning to form ideas as to what their future careers are to be, and how they may best attain them. These boys are the raw material. They need to be guided. If they are guided properly and seek the right kind of an education for a professional career in engineering, the schools must respond.

Unfortunately, engineering education is being *sold* in a commercial sense. A great many—and it may even be safely said, a majority—of the students entering the engineering courses, do so because they have been led to believe that it is a quick road to self-support. The acquiring of a professional education has probably been of secondary importance with them.

This being the condition, it has been a case of obtaining the maximum amount of quickly negotiable information in the shortest possible time. Probably many of our technical schools have responded to this demand and even have competed to supply it. They have been in the market primarily to get the maximum number of students. They have been seeking quantity rather than quality, and by so doing they have cheapened engineering education.

The Professional Attitude

Law and medicine, on the other hand, have long enjoyed a high prestige as learned professions. The young men selecting these professions as careers, have, to a greater extent, been actuated by a different motive. They have looked ahead to the future. They have considered the high standing in the community which most lawyers and doctors enjoy.

It has been the professional career which has attracted them—not the expectancy of quick return—not merely the acquisition of knowledge to permit them to carry on a vocation. This difference in mental attitude toward what they are setting out to do, is, I believe, the underlying reason for the great difference between engineering education and that provided in law and in medicine.

In one case vocational training is sought; in the other, a professional career. The engineering schools seem to strive to supply the vocational training. To do so satisfactorily, they must constantly change their courses to include the most up-to-date and saleable information. This accounts for the condition of affairs so forcefully set forth in the last part of the first paragraph of Prof. Burr's address, which I quote as follows: "In other words, the whole field of engineering education seems to be in a dynamic condition, or perhaps we may better put it, in a state of violent ebullition, without any surface evidence of having stable strata at any depth whatever."

Our technical institutions should be concerned more about the quality of the graduates, than of the quantity. A great many of them are crowded. Their equipment must be expanded if more students are to be accommodated. Instead of providing for the increase in numbers, why not grasp the opportunity and raise the standard of the education, and by so doing, automatically eliminate the less desirable?

Or, if large numbers must be educated, why not differentiate their education? Why not supply the vocational training for the students who happen to want that kind of an education?

And why not reserve professional degrees for those students who are able, and who desire to acquire the education that a learned profession should have?

Until their education is of the same high quality in every respect, engineers will never be accorded the same professional recognition as is enjoyed by those practising law and medicine.

I have believed this for many years, and have sought to have the professional degree given only to those students who can find the time and money to enable them to superimpose their professional education upon a general college education as a foundation. In other words, I believe a professional degree in engineering should be a post-graduate degree, as it is now with law and medicine, in the best professional schools.

I fully concur with Prof. Burr in advocating a six-year course in engineering, with a professional engineering degree at its completion. But I would partly parallel this course always with the so-called vocational training course of three or four years in length, and recognized by a Bachelor of Science degree. Such a vocational course and such a Bachelor of Science degree would supply the rank and file of engineering workers, who do not now, and never will attain to a high position as professional engineers.

Thunderstorm-Breeding Spots and Engineering Design

AFTER discussing the probability that thunderstorms are likely to develop with more frequency in certain localities than in others, due to local conditions, Robert E. Horton, consulting engineer, Voorheesville, N. Y., suggests in the April *Monthly Weather Review* that the subject is worthy of study because of its relation to the design of engineering works. Mr. Horton notes that he has observed thunderstorms over cities, particularly Albany, N. Y., and Providence, R. I., "which originated immediately over the city and did not travel far outside their limits on days when there were no other adjacent thunderstorms." He expresses the belief that "some cities, if not indeed most inland cities of say 100,000 population or more, appear to be thunderstorm spots." He also points out that "a shallow lake with sandy margins located in a forest may serve as a thunderstorm breeder" and cites as proof observations made by him over Oneida Lake, N. Y. Furthermore, "Some western arroyos are notable for the frequency of occurrence of so-called cloud-burst thunderstorms" . . . "whereas another adjacent to it might rarely produce them." The desirability of observations to show what particular areas, rural or urban, are what Mr. Horton terms "thunderstorm-breeding spots" is urged as bearing upon the design of dams and of sewers. What Mr. Horton says in conclusion about cities breeding thunderstorms and the relation of this possibility to sewer design follows:

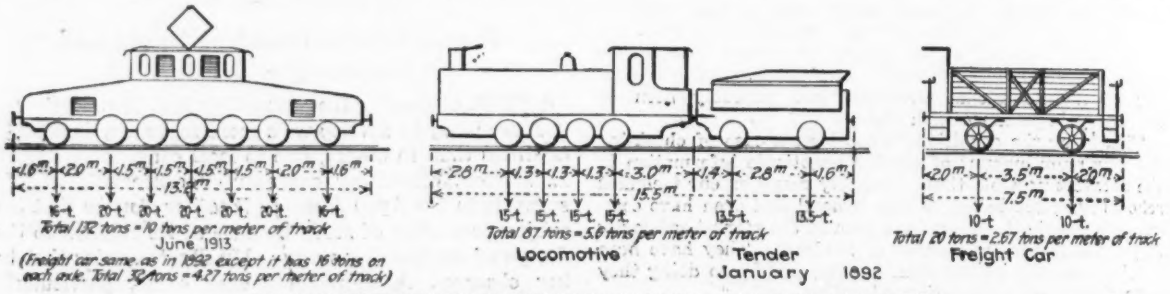
"An indication of the truth of the supposition that cities breed thunderstorms might be obtained by comparison of rain gages in the surrounding country with records taken in the city during the thunderstorm months. Records of the number of thunderstorms taken in large cities are probably not sufficiently accurate to afford a reliable basis of comparison with thunderstorm frequency in the immediate surrounding country. Should it prove true that cities are in some instances thunderstorm breeders, whereas other nearby cities may not possess this characteristic, then such facts might have a very important bearing on various engineering problems, notably storm-sewer design, and might vitiate the utility of application of records of thunderstorm rain intensities in one city to another nearby city, even though the climate of the two places and the total rainfall per annum might be very nearly the same."

Swiss Technical Notes

Improvement Program of Federal Railways Includes Double Tracking, Bridge Reinforcement, Electrification and Stations

By Engineering News-Record's Swiss Correspondent

COMPARATIVELY a new undertaking, the Swiss Federal Railways have developed greatly since the popular vote of Feb. 20, 1898, which provided that the state take over the Swiss railroad system, with the slogan "The Swiss Railways for the Swiss People." In carrying out the new federal law, the state took over the Central R.R., the Northeast R.R., and the United Swiss Rys., Jan. 1, 1901, and in 1903, the Tura-Simplon road. With the taking over of the Gotthard road in 1909, the buying in of the principal privately owned lines was concluded. Since that time an extensive improvement program has gone forward including double tracking, bridge reinforcement and replacement, heavier rail and track, electrification, and new stations. In the meantime some of the smaller and less important lines have also passed over to the state, and in 1919 the Swiss federal railways comprised 2,755 km.


1.6m 2.0m 1.5m 1.5m 1.5m 1.5m 2.0m 1.6m
13.6m
15-t. 20-t. 20-t. 20-t. 20-t. 20-t. 15-t.
Total 132 tons = 10 tons per meter of track
June 1913
(Freight car same as in 1892 except it has 16 tons on each axle. Total 32 tons = 4.27 tons per meter of track)
2.8m 1.3 1.3 1.3 3.0m 1.4 2.8m 1.6m
15.5m
15-t. 15-t. 15-t. 15-t. 13.5-t. 13.5-t.
Total 87 tons = 5.6 tons per meter of track
Locomotive
Tender
January 1892
2.0m 3.5m 2.0m
7.5m
10-t 10-t.
Total 20 tons = 2.67 tons per meter of track
Freight Car

OLD AND NEW STANDARD BRIDGE LOADINGS OF SWISS RAILWAYS

Right two diagrams specified in first Swiss decree governing calculations of iron bridges in 1892. Left-hand diagram indicates standard loadings as required by a decree of June 7, 1913.

As in other countries during the transition period from private to state control, the first few years of operating the federal railways naturally entailed many difficulties. Further considering the fact that, after barely ten years of government control, the World War intervened with its very serious effects on neutral Switzerland, shut in on all sides, it will readily be recognized that the federal roads are experiencing great difficulties in maintaining a balance between income and operating expenses and at the same time trying to carry out a program of improvement.

The original investment in the lines of the federal railways was 1,062 million francs. The improvement program to date represents an additional 469 million francs for capital account, so that new expenditures amount to about 44 per cent of the original investment. Included in important betterment work may be mentioned the completion of the Simplon tunnel, started by the Tura-Simplon road, the total cost of which was 81,000,000 francs, which included the 35,000,000 francs expended by the federal railways to complete the work. Net profits of operation of the Swiss Federal Railways per kilometer of line operated, since 1903, at intervals of four years, were as follows: In 1903, 15,749 francs; in 1907, 18,873 francs; in 1911, 26,113 francs; in 1915, 18,109 francs, and in 1919, 20,800 francs.

Up to the end of 1919, 357 km. of single-track line had been double tracked, so that the total length of double track has been increased to 898 km., or 32 per cent of the total length of line. This may seem a small proportion of double tracking in comparison with railroad systems of other European states, but it must be considered that physical conditions in Switzerland are considerably more difficult. In this respect those who know Switzerland may be reminded of the international character of the Gotthard road, the difficult Brunner-Fluelen division of which still awaits double tracking. Nevertheless, this single-track section has to meet the heaviest traffic demands, and in 1913 sixty-eight trains per day passed over it without accident, while in general sixty trains per day had been considered the limit for safe operation.

An important feature of the development of the federal railways has been the program of bridge reinforcement and heavier rail and track which followed the introduction of bigger power. In 1903 there were only some 94 km. of track laid with rail of section heavier than 45 kg. per m., but at the end of 1919, 2,350 km. of line was equipped with heavy section rail. The increase in track loads resulting from the introduction of heavier locomotives required the reinforcement and replacement of existing iron bridges, in accordance with new loading standards shown in the accompanying diagram in comparison with the old standard of loading. Even the new standard loadings have again been exceeded with further development in the program of electrification and new electric locomotives having axle loads of 25 tons and 11 tons weight per meter of track.

More than 8,000,000 francs were required for the rebuilding and reinforcement of bridges alone up to the end of 1919. A series of rather small iron bridges was replaced by more massive structures. On the thirty-two iron bridges remaining, regulations are in force providing limiting speeds, prohibition against two trains crossing double-track bridges at the same time, and prohibition against braking on the bridges.

Large sums have been required in the construction of station buildings and stations. The program still provides for the building of eighty new stations, fifteen of which are in the course of construction. A total of 550 million francs will be required for this work, of which 100 million alone is to be provided as a first installment for the reconstruction of the station at Zurich.

Greater safety of operation has received careful attention in the program for improvement by the construction of additional block sections, telephone block dispatching and warning signals, and in the rapid replacement of oil lighting by electric signal lighting. Switches on express tracks are being equipped with

"double tongue locks" so that it will be possible to operate express trains over them without decreasing speed.

Finally, in recent years, larger sums have been required to initiate the program of electrication, which is now fully under way. In addition to the building of the usual transmission lines and overhead and the building of electric traction equipment, the work involves three railway power plants in Tessin, Reusstal and Wallis that are now under construction.

If this entire program of improvement and reconstruction should be carried out within a period of fifteen years, it would require capital expenditures per year, according to the report of the general management of the Swiss Federal Railways, of the following amounts:

	Million Francs
Reconstruction and extension of station buildings and station equipment	37
Double tracking	25
Bridge alterations, interlocking and signal devices, telephones, telegraph, furniture, etc	15
New lines	3
Electric traction	40
Rolling stock	30
Total	150

However, the effects of the great war on raising capital will probably not permit such rapid completion. Therefore, it is intended to proceed with electrification according to a program already approved with construction expenses provisionally reduced.

The Swiss people have made a large sacrifice to create and improve the state railway system. Small Switzerland, with an area about half that of Lake Superior, has done everything within its power toward developing transportation and tourist traffic.

Wood Pipe Preferred for Tunnel Ventilation

In taking over the work of driving 10 miles of tunnel in the mountain division of the Hetch Hetchy project, A. C. Dennis discontinued the use of 24-in. steel ventilating pipe and substituted wire-wrapped wood-stave pipe 14 in. in diameter. This has now been in use in the several headings for about 8 months, and Mr. Dennis states that it is more easily placed is the metal pipe, requires fewer supports, is much more likely to remain tight and is less subject to leakage due to being thrust slightly out of alignment. The chief advantage of the wood-stave pipe, however, is that it is not easily damaged by flying rock fragments, which makes it possible to carry it close to the heading. The metal pipe was not ordinarily placed nearer than 250 to 300 ft. of the heading, due to the danger of damage from flying rocks. This left a pocket or dead-end from which the foul gas cleared much more slowly than in the case of a ventilating pipe that could safely be carried closer to the heading. The wood pipe is ordinarily kept up to within about 50 ft. of the heading and at this distance gives less trouble in maintenance than did the metal pipes terminating 200 ft. back of the heading.

French to Irrigate the Niger Valley

Irrigation of 1,870,000 acres of land in the Niger River Valley of the Soudan within 12 years is the intention of the French government according to a recent report from the French Commission in the United States. The work will involve an impounding reservoir at Lake Faguibine, diversion dams and canals.

Causes of Equipment Delays in Highway Construction

Careless Operatives Increase Accidents—Poor Standardization Delays Repairs—Lack of Data on Efficiency

By R. C. Marshall
General Manager, Associated General Contractors of America, Washington, D. C.

The equipment ideal of the paved road builder is a light mobile plant capable of handling, mixing and finishing 400 cu.yd. of concrete every day, with no delay for repairs.

Few road construction plants attained this ideal in 1919 and 1920, the two greatest years of paved road output in the history of American road building.

There were various reasons for this failure, but the two most important were poor railway transportation and delays due to construction equipment troubles.

In the article which follows, the latter difficulty is discussed by the spokesman for the Associated General Contractors of America at the meeting of the American Society of Mechanical Engineers, Chicago, May 26, 1921.

Briefly the task is laid upon contractors of providing skilled mechanical direction and operation of construction machinery, and upon equipment manufacturers, of standardizing design and of presenting reliable information of machine efficiency.—Editor.

EQUIPMENT delays in highway construction are due mainly to lack of skilled mechanics, lack of standard ization in design and lack of accurate information concerning adaptability, capacity and operation of machines.

The lack of skilled mechanics concerns both manufacturers and contractors. An equipment company may expend much time and money in perfecting design or improving workmanship, but if its machines are placed in the hands of incompetent operators, the money spent is wasted. Incompetent operators can readily offset the advantages of efficient equipment and well-planned work. Heavy delays for repairs due to careless operation means a loss of money to the road builder, and loss of that valuable asset, good will, to manufacturers.

The shortage of good operators might be relieved by establishing a short course of instruction for mechanics. During winter months when construction is slack these men could be instructed at the manufacturers' shops or possibly at some of the engineering schools. In either case they could be instructed to operate and exercise care in maintaining equipment. Savings effected in the field by competent operators would amount to many times the cost of their instruction. One of the worst obstacles to continuous output would thus be removed.

Standardization Badly Needed

The second significant source of delay is a lack of standardization in equipment when standardization is possible. Road building plants are generally made up of machines from half a dozen different manufacturers and to be prepared even for the usual run of minor field repairs on all machines requires a more or less elaborate machine shop. The financial burden of carrying duplicate units or a sufficient number of spare parts is too great for an already heavy overhead, and in order that this expense may be held within reason, greater interchangeability of parts should be possible.

It is not expected that a mixer casting should be adaptable to a locomotive crane, but the interchangeability of parts on different portions of the same machine can undoubtedly be increased. Undue variation in the pitch of threads is an inconvenience which might be materially lessened or removed. It is not practicable in a small construction machine shop to carry stocks and dies for every

thread in the outfit, and yet if this is not done, some insignificant bolt may hold up the work for several hours or a day. By reducing the number of different sized bolts and threads, many more repairs could be made at the site of operation.

Gas engines are especially annoying when a breakdown occurs. Repairs usually involve a shipment of some part by express. In the meantime the work is delayed and the overhead is absorbing profits. Even allowing for difference of opinion in designs, the power delivered by a gas engine surely bears some definite relation to size of bore and bolts that would permit more uniformity in their manufacture. Any uniformity that can be effected will be reflected in the cost of road construction.

The amount of saving that might be effected through standardization of road equipment is not generally appreciated. To build a medium-sized, high type section requires a daily field payroll of $300 or $400 and an overhead of probably another $100, so that $500 a day is not an unusual cost. Employees cannot be laid off every time a breakdown occurs, and since the overhead goes steadily on, $50 an hour may be considered the cost of equipment delays.

By bringing about some degree of standardization, many more repairs could be made quickly in the field, and the saving would accrue to the public in lower highway costs. At present these costs are discouragingly high and it is the duty of every group of men involved in construction to place their energies squarely behind the movement to bring costs within reason. It is exceedingly doubtful whether the present equipment expense of high type roads is justified, and if it proves not so, mechanical engineers and contractors will have an interesting problem in cutting the expense to economical proportions. This problem will involve, and to some extent depend upon, both the standardization of equipment and instruction of mechanics.

For every type of machine sold the manufacturer should prepare at least two assortments of spare parts to be sold at a stipulated price with his machine. The assortment should be based upon actual experience in operating similar machines. The mere fact that there are parts so listed should not detract from the value of the machine but a grossly erroneous list would surely militate against its future sale. These lists, besides their value to the highway contractor, would keep vividly before the designers the number of different kinds of vulnerable parts and would tend to encourage standardization and simplification.

Reliable Equipment Advice Essential

The third pressing need of road builders, and the one which probably results most frequently in disaster, is a lack of unbiased and authoritative information concerning the adaptability, capacity and operation of machines. Lack of such information has already brought disaster to numerous individual companies, both old and young; and as new concerns are constantly taking up road work, it is essential that they secure authoritative mechanical advice.

The road program has so expanded that to complete the work desired by each state many companies new to road work must be relied upon. These companies have not always realized that problems of road construction differ vastly from those on work confined to a small area, and in choosing their method of operation they have made grave mistakes. Many of these mistakes are due directly to a lack of authoritative information which should be available in any country as widely developed as the United States.

It is a significant fact that in writing to a manufacturer for information the reply almost invariably comes from the sales department. Frequently the reply is entirely unbiased, or apparently so, but more frequently the writer, if a contractor, is apt to be deluged with a mass of sales literature and glowing testimonials. He may be informed that the district salesman will call and take his order, all of which leaves the hurried contractor exactly where he started. That is not engineering service.

Manufacturers in some instances do supply engineering service—supply it in profusion. In fact, a prospective road builder can hardly escape it, but the service is not of the kind that contractors need. It is a combination of salesmanship, estimating and civil engineering—all of which a live construction company possess in abundance.

What contractors need are accurate data showing under what conditions a certain type of machine is suitable, how long it may reasonably be expected to last and what output it can deliver under normal working conditions. If this information can be made available, construction companies may be relied upon intelligently to select machines. They will then be able to co-ordinate their plant and estimate their costs.

A questionnaire sent to a hundred manufacturers in 1920 showed that they possess practically none of this needed information. A few of them were able to state figures for depreciation, but the figures would unquestionably cause an unwary bidder to underestimate. One firm gave twenty years as the average life of a slip scraper. Yet an earth mover knows that constant use of a slip may wear it out in a season. This is merely an example to show that manufacturers themselves are frequently lacking in facts concerning their own equipment.

Collecting the information needed by equipment owners may not be strictly the work of mechanical engineers but it would undoubtedly be of assistance to them. They would, moreover, perform a valuable service by undertaking the task so that contractors could rely upon the accuracy of their information. It is principally by securing dependable information and by bringing about co-operation between the constituent industries of construction that the leaders in construction expect to make it an efficiently conducted industry.

Hudson River Pontoon Bridge Preliminary Plans

Anticipating the passage of the Hudson River Pontoon Bridge Co. bill recently introduced in Congress by Senator Frelinghuysen of New Jersey, as reported on p. 207, Aug. 4, Gustav Lindenthal, consulting engineer, is developing the plans for the structure. He gives the following as the principal features of the proposed structure:

Highway traffic exclusively is to be accomodated by the proposed bridge. The deck will provide a 30-ft. roadway and a 10-ft. sidewalk, and will have an underclearance height of 40 ft., bringing the roadway about 50 ft. above water. On the Yonkers or east side the bridge will land on Hawthorne Ave. near the foot of Downing St., giving direct traffic connection with the main routes south, east, and north. On the west side the line encounters the vertical face of the Palisades, at this point about 450 ft. high. The new Palisades Park road extends along the face of the cliff 90 ft. above water or 40 ft. above the bridge roadway level; connection will be made to this road by approaches rising on 5 per cent grade along the slope at the foot of the cliff.

The main or pontoon-supported part of the structure will be in the neighborhood of 4,800 ft. long; this is to be flanked by a short section of timber trestle supported on piles on either bank, and a span over the New York Central right-of-way on the east bank. The wooden vessels of the Shipping Board which it is proposed to use as pontoons for carrying the main bridge, of about 4,000 tons displacement, are to be placed 160 ft. on centers, bow upstream, and will be moored by cables attached to screw-pile anchorages at a distance of 300 or 402 ft. up and down stream. On account of the great depth of soft bottom these piles will have to be put down to a considerable depth, possibly 100 ft. or more. The superstructure carried on the pontoons will consist of four lines of lattice girders, floorbeams resting on them, and a floor of double planking directly on these beams. The width of the ships being about 46 ft.,

clear openings of something over 110 ft. will be obtained. A drawspan will be provided.

Because of the large amount of wood in the structure a complete fire-protection system will be provided. The principal other natural difficulty to be contended with is the possibility of ice pressure in winter. The tidal currents at the site of the bridge have a velocity of 3 to 4 miles per hour and there is a possibility that a large field of ice moving in this current might put excessive pressures on the moorings. To guard against this danger ice-breaking vessels will be provided, to operate across the river along the bridge in winter and break up field ice.

Present estimates indicate that the structure can be built and put in service for a sum within $2,000,000. The tolls to be charged will be under the control of the Secretary of War, according to the chartering bill. The structure must be removed at the end of ten years, within which time it is belived possible to complete the permanent bridge projected at 57th St., New York City, by the Hudson River Bridge Corporation, made up of related interests.

Tuning Up Anew an Eight-Year Old Filtration Plant

Inadequate Mixing and Bypassed Untreated Water Produced Uncoagulated Water—Mudballs and Inverted Gravel Result

WHEN the filter plant at Waco, Texas, was built in 1913 it was provided with the most modern equipment. (See *Engineering Record* June 20, 1914, p. 694.) Recently the plant has had a thorough overhauling and the designs checked with present day practice, particularly with reference to the mixing chamber, settling basin and the baffles. C. Arthur Brown, consulting engineer, in making a report on the plant to E. L. Fulkerson, superintendent, states that due to insufficient coagulation and subsequent imperfect sedimentation the uncoagulated sediment clogs the filters rapidly, lowers the efficiency of the filters, has a tendency to cause mud balls, hard spots, bed settlement, breaking of the sand bed away from the side walls and inversion of the supporting gravel. The following notes are from the report:

The most serious errors in design now apparent were made in the mixing chamber. One of these resulted in the top of the mixing chamber and the floor of the filter gallery being placed at the same elevation. Another resultled in a number of openings in the walls between the different compartments of the mixing chamber. Because of the lov elevation of the mixing chamber it is impossible to get enough head to create sufficient velocity to carry along the suspended matter. At least 4½ ft. of head should have been allowed. As the laboratory and coagulant apparatus are built over the mixing chamber it is impossible to correct this difficulty. By rearrangement of baffles in the mixing chambers and reducing the weir height between the settling basins and filters, a small amount of head was made available, but the real cure lies in building a new chamber.

The mixing chamber is divided into two halves by an east-and-west wall. The north section is divided into three compartments by two division walls running north and south. The one to the east is the accelerator chamber, the one to the west is the mixing chamber proper and the central compartment is the flume chamber. The untreated water enters the accelerator chamber through a 30-in. cast-iron main, in which there is installed the accelerator or pressure difference tube equipped with pitot and piezometer tubes in its throat. This accelerator ends in a 30-in. flange and spigot ell which is turned downward, causing the flow from the discharge to impinge against the floor. In the wall between the north and south halves there is one large opening near the floor through which the water passes from the accelerator chamber to the south half of the mixing chamber and in addition there are a number of smaller openings, also at the floor line, through which water may flow from the accelerator chamber to the south half of the mixing chamber. An equal number of these small openings of the same size, about 4 in. square, are to be found in the wall between the accelerator chamber and the flume chamber, which enables flow to occur between these two compartments.

The normal course of flow through the mixing chamber is into the accelerator chamber near its west end, thence to the east end of the chamber and through the large opening at the floor line into the east end of the south half of the mixing chamber. Flowing westwardly to the center of this chamber, it passes through old wooden baffles to the west end of the south half and discharges under the middle wall at the floor level into the real baffling or mixing chamber compartment of the so-called mixing chamber. The baffles in the south half of the mixing chamber perform no useful function and might as well not be there for any good they do; in fact, they might better be removed as they are an actual hindrance to the plant.

Insufficient Baffling

Just after the flow passes from the south half of the mixing chamber into the real mixing chamber section, or the west section of the north half, the chemical treatment of caustic lime and sulphate of iron is introduced into the flow. From here on until the water leaves the west compartment, the water is compelled to flow over and under a number of baffles, making several up and down cycles of flow, at so low velocity as to be of little benefit. From the mixing section it flows into the flume section, which is unbaffled. This central or flume section serves as a distributing point to effect flow into the two settling basins, two flumes taking off from the flume chamber at the bottom and extending through the mixing chamber section and the accelerator section into the bottom of the western half of the western settling basin and the eastern half of the eastern settling basin.

These flumes discharge at the bottom of the settling basin sections through a number of small openings which look upward. As originally constructed, the openings from the flumes discharged horizontally, but the flow in this direction created so much scouring action across the bottom of the settling basins that the openings were changed to a vertical discharge. To secure a proper distribution of flow, a baffle was built in front of these flumes and the upward flow was made to pass over the top of this baffle to enter the settling basins. The benefits from this change were immediately apparent.

About five-sixths of the space in the mixing chamber is either unbaffled or baffled so as to give no results of any value.

The chemicals, being introduced after the flow has passed through two-thirds of the mixing chamber, are then only very inadequately mixed with the water, with the result that the floc is not well formed. The openings between the accelerator section and the flume section permit a very considerable volume of flow to pass directly from the accelerator section to the flume section, none of which receives any chemical treatment. The mixture of untreated raw water and treated water passes through the flumes to the settling basins. Although the percentage of untreated water as compared to the volume of treated water is relatively small it is just about ample to nullify the effects of the chemical treatment in the treated water.

As a result of this deplorable condition in the mixer, the water entering the settling basins is not completely coagulated nor in fit condition to undergo sedimentation. It is smoky and streaked and cannot be made to settle clear. The fine, uncoagulated sediment rapidly clogs the filters and lowers the efficiency of filtration. It has a tendency to

cause mud balls, with all their attendant evils, from which this plant is now suffering. If permitted to continue, we may confidently expect to see hard spots continually developing, even to a much greater extent than they now exist. Evidence of bed settlement, with the filter beds breaking away from the walls, is now observable. Hard spots have been found and if these things were to be permitted to continue, cracks and crevices would surely follow the present bed inversion found in one of the filters.

When the water level in the filters was drawn down a careful investigation indicated that the filter beds were in poor condition. The sand showed unmistakable evidence of bed settlement, which manifested itself in a pulling away from the walls of the filter. The sand level was too high, a part of each wash trough being buried in sand. The sand was heaped up between the wash troughs and from 60 to 80 sq.ft. of filter bed were rendered ineffective by the high sand level. When the air was turned on, it did not break evenly, there being no considerable uniformity even after the air had been applied for several minutes. When one of the filter beds had been opened down to the gravel, the conditions were found to be considerably worse than could have been anticipated from the surface indications aside from the mud balls. Not only had the mud balls penetrated the filter bed to the gravel layer but to a considerable extent they had even penetrated the gravel. Hard spots of considerable area were found, practically blanketing the bottom over these areas. Bed inversion had taken place, considerable areas of the gravel layer had lifted from 4 to 8 in. In fact, all the indications were that filtration efficiency had practically ceased and that if the plant had been permitted to continue in operation on the same basis the time would have arrived at a fairly early date when it would have proved impossible to obtain enough filtered water through the beds to have met the needs of the city.

The recommendations made and put into effect consisted of the following: To remove all sand and gravel from each filter bed in turn; to remove and clean the air manifold; to secure 6 in. of gravel of approximately 3-in. diameter and place it above the water strainers in the filter bottom; to screen and grade the present gravel and replace it on top of the 6 in. of new gravel; to raise the air manifold from 6 to 8 in. above its present location; to add about 2 in. of new sand to the old sand to give the requisite layer of fine sand on the surface of the filter bed, keeping the bed at least 2 in. below the bottom of the wash troughs. The sand has increased in size and weight by accretion but the specific gravity of the material as a whole has decreased. The percentage of increase by volume is 31.58 per cent, while the increase by weight amounts to only 15.62 per cent.

Among the things which are practically worn out may be mentioned the solution tanks for sulphate of iron. These tanks are leaking in a number of places and have already been patched up a number of times. The lime tanks are in better condition, practically as good as when new. The equipment of both lime and iron tanks is practically worn out and will shortly have to undergo repair or replacement, which will be rather expensive. Dry-feed mechanical machines, not available at the time the plant was built, are now perfected sufficiently to warrant their use. Rather than rebuild the chemical tanks and apparatus, I suggest that three dry-feed machines be equipped to operate on functional control. The plant at the time it was built was not equipped with a recording meter to measure the flow into the plant. An accelerator tube was provided, however, and this was used to actuate the wet feed chemical devices. This accelerator tube can now be utilized to actuate the dry-feed chemical machines in the same way.

The individual filter controllers and the master controller are in fair condition and could be made operative without a great deal of trouble or expense, but none of these controllers are now in service and have not been for a very considerable period of time in the past. I am strongly of the opinion that you will never be able to do much better with them in the future than you have in the past. A part of the troubles you have experienced with your filter bottoms may be charged to this lack of filter control and I believe you will always have more or less of this trouble unless a better practice is followed. It is recommended that the present filter and master controllers be replaced with a more modern type which will not only control the flow from the filters but also meter it, the master controller metering the total output of the filters. I should expect to utilize the accelerator tubes of the present controllers, selling the hydraulically-operated throttling valve and replacing it with a diaphragm-operated throttling valve. The price obtained for the one should go a long ways toward paying for the other.

Timber Truss Roof Designed for Special Conditions

BY THE special design of a 76-ft. timber truss roof which would not require large timbers or steel rods and which would utilize material on hand in relatively small sizes a saving of 20 per cent in cost was effected in the construction of a new freight-car repair shed for the Atlantic Coast Line R.R. at Waycross, Ga. This is

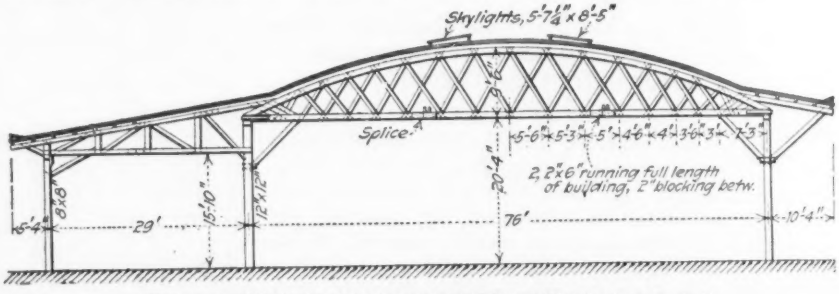


FIG. 1. TIMBER ROOF FOR CAR REPAIR SHED, A. C. L. R.R.

the saving estimated by the railway officers, who state also that there was a reduction of about 30 per cent in the time of erection as compared with the original design for ordinary wood truss construction requiring larger timbers. The greatest saving or advantage, however, was in the fact that car repair work proceeded without interruption while the shed was being erected and the roof trusses were placed, as temporary abandonment of the repair tracks had been expected.

The 76-ft. timber trusses designed for this work have curved top chords of 9½ ft. rise and a web system of intersecting members, as shown in the general and detail drawings, Figs. 1 and 2. The chords are in two parallel sections, with the ends of the web members bolted between them. Each portion of the top chord consists of six 2 x 3-in. pieces laid flat, bent to the required curve and nailed together at 18-in. intervals. For the bottom chord there are two pieces 3 x 8-in., with splices at the third-points of the span. Web members are 2 x 6 in. except that at the ends they are 2 x 8 in. and placed close together.

The ends of the bottom chord are shaped to butt against the top chord and a heavy steel strap is put around each end of the truss, this strap having side angles which rest on a wall plate laid along the tops of the side posts of the building. Knee braces extend from the posts to the truss chords and the wall plates. Joists 2 x 8 in., with overlapping ends, are laid across the top

chords and nailed in place, the plank sheathing for the roof being laid upon these. Upon the bottom chords are laid two lines of longitudinal timbers to carry hoists for use in car repair work.

This repair shed is 672 ft. long, except that a 30-ft. gap is left at the middle in order to reduce the fire risk. Its posts and trusses are spaced 15 ft. c. to c. The 76-ft. roof spans four repair tracks and a service track. At one side is a 29-ft. span over the machinery space and blacksmith forges, and at the other side is a 10-ft. lean-to or shelter roof. Light is provided by a metal-frame skylight in each bay, these skylights being on opposite sides in alternate bays.

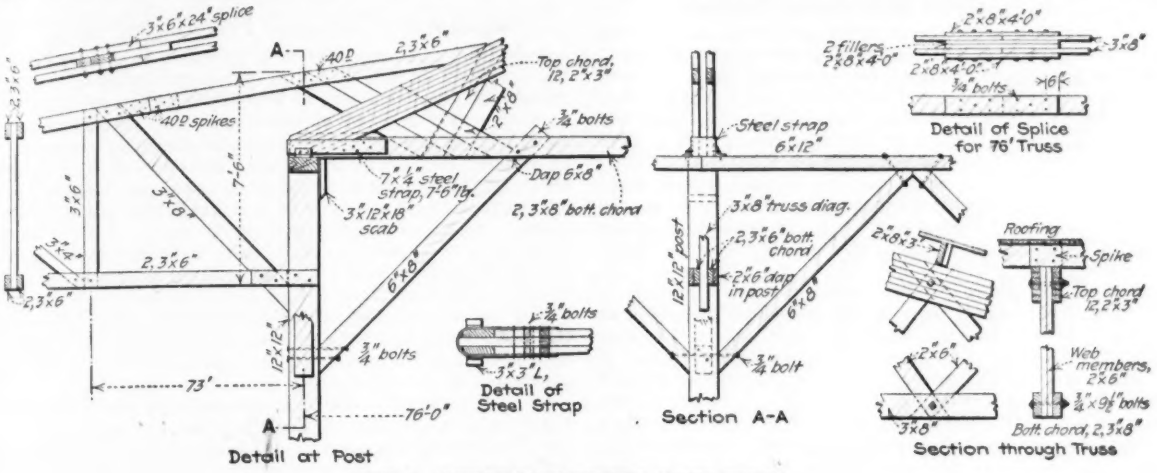


FIG. 2. DETAILS OF TIMBER ROOF TRUSS

Assembly of the trusses was done at a framing yard 2,000 ft. distant. Each truss was carried to the site by a locomotive crane, and after being raised parallel with the track to a sufficient height to clear the posts, the truss was swung round and placed on the wall plates. Only about 18 minutes were required to transport a truss and set it in position. The entire structure was erected in forty eight-hour working days by a force averaging two foremen, a timekeeper, sixteen mechanics and twelve laborers. The trusses are said to have cost less than $2 per foot of span.

With a cost of $43,000 for the structure the cost per square foot of area covered averaged 19c. for labor and overhead and 56c. for the building complete. This design, as a substitute for the railway company's plans, was submitted by George F. Jenkins, president of the George B. Swift Co., contractors, Chicago, and Savannah, Ga. The timber truss was designed by William J. Summerbell, Chicago, who has patents pending. The work was carried out by the George B. Swift Co.

Fewer Horses in Cities

The extent to which horses are being displaced by motor vehicles is shown by the report of the Bureau of the Census covering the number of horses in various cities. The decrease in the number of horses in New York in 1920 as compared to 1910 was 40 per cent. The percentage of decrease in certain other cities is as follows: Chicago, 44 per cent; Boston, 43 per cent; Cincinnati, 36 per cent; Cleveland, 30 per cent; Pittsburgh, 46 per cent, Baltimore, 48 per cent, and Philadelphia, 38 per cent.

Tunnel Lining Continued Beyond Portals for Protection from Slides

IN REPLACING timber lining with concrete on railroad tunnels of the Tehachapi Pass, a variation from standard was followed on the west ends of Tunnels 4 and 6, where there had been considerable difficulty with slides. Using the usual tunnel forms on the inside, and building up outside forms of wood, the concrete lining of these tunnels was continued as a protective tube for distances of 76 and 60 ft. respectively into the open. The walls of the tubes were made 13 and 16 in. thick respectively and have the same reinforcement ordinarily used in the tunnel lining. Buttresses were

SLIDES AT TUNNEL 6 REMEDIED BY EXTENDING LINING

placed on the downhill side of the tubes to resist a tendency to slide. These buttresses are 15 in. thick and 10 to 12 ft. long in the footing and were placed 11 ft. apart on Tunnel 4 and 13 ft. apart on Tunnel 6.

At Tunnel 6 the first remedy tried was the construction of a retaining wall to hold the toe of the slope. This did not accomplish the desired result so the full tunnel arch was built, as shown in the accompanying illustration, for that part of the retaining wall where heavy sliding was common. At Tunnel 4 no experiment with retaining walls was made, the concrete arch being built up for the full length of the slide when the tunnel was lined the standard portal and wing wall construction being used to finish off the end of the concrete tube.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

San Francisco Bay Tunnel Project

Sir—For earliest possible realization of the bay crossing project at San Francisco it seems to me unwise to bother with the question of suburban traffic at this time. We have the best and the cheapest suburban service from San Francisco to Alameda County that I have seen anywhere in the country, and there is no need to improve further upon it at this time. Perhaps when there are 2,000,000 or 3,000,000 people around the bay it may be advisable to have some other means of accommodating this traffic, but at the present I see no reason whatever for a change, except a possible objection to crossing the bay by boat in foggy weather.

If the proposed causeway and tube are confined to vehicular traffic, the cost will not exceed $15,000,000 and the crossing will supply service for which there is a real demand. Revenue could be obtained sufficient to pay a decent interest on the cost. There is a tremendous demand for improvement in vehicular traffic, while I do not believe there is any very strong demand for change in suburban service. In any event, it is perfectly possible to expand the causeway and build additional tubes whenever the time is ripe for running trains and street cars across the causeway to get rid of the ferry service.

C. H. SNYDER,
San Francisco, July 26. Consulting Engineer.

Open Shop for Builders in Buffalo

Sir—My attention has recently been called to an article in your issue of May 26, 1921, p. 886, which is quoted from a letter written by William J. Barney, of New York, to a prominent manufacturer of Buffalo.

Mr. Barney shows strong pro-union sympathies and gives as his excuse the same stock reason which has been advanced from time to time immemorial, namely, the difference in the position of the contractor and the manufacturer, as regards labor conditions.

There is much truth in the statement that the manufacturer, having a more or less permanent organization, is in a better position to assert his independence, but the fact remains that the contractor in spite of adverse circumstances can obtain the same degree of liberty, if he is possessed of a real desire to be free of union domination. This is proved by the fact that there are a number of contractors who have successfully freed themselves from union rule and are and have been for many years maintaining their independence.

To be sure, they started with a genuine wish for freedom, reinforced by a firm determination to have it. The unions, not slow to recognize the strength of character of such men as these, soon learn to respect them and eventually decide to let them severely alone.

If the Barney-Ahlers Co. prefers a union organization, their preference should be respected and so far as the writer knows, was duly respected when they were working in Buffalo, but for Mr. Barney to say that open-shop conditions in Buffalo are theoretical, is hardly fair, for they are beyond doubt very real, as he could easily have ascertained, had he so wished, by a positive attempt to work certain trades under open-shop conditions.

It is only fair to admit that it is hard for a builder whose work is not strictly local, to enforce the open-shop rule, but it has been done in Buffalo during the past year by a contractor who worked open-shop men here, while working union men exclusively on jobs going forward in closed-shop cities.

He says he worked here under the "so-called open-shop conditions" and I, for one, am glad to know it, for he saved himself a deal of trouble thereby, as he certainly avoided strikes resulting from broken agreements and jurisdictional disputes and his project went forward without any delays of which we have heard. Everyone agreed that his work was completed in record time.

F. N. FARRAR,
Secretary, Builders' Association
Buffalo, N. Y., Aug. 1. Exchange of Buffalo.

Engineering Courses of Professional Grade

Sir—I am not sure that it is desirable to discuss Prof. Burr's paper in the technical press and thus leave the Society for the Promotion of Engineering Education less to do with this discussion at its next annual meeting, but I should like to call to your attention the fact that the College of Applied Science in the State University of Iowa is in entire sympathy with Prof. Burr's proposals, as is evidenced by the following resolution or statement that was adopted by the Faculty of this college last April:

"1. It is desirable to establish five-year engineering courses, the first year of which should be given in the College of Liberal Arts and no specialization made except in the course in chemical engineering until the fifth year, the establishment of such five-year course being considered as a preliminary step toward the establishment of six-year courses.

"2 That it is desirable first to make an effort to have the American Engineering Council of the Federated American Engineering Societies establish standards of engineering education and for engineering colleges of different grades; and to rate the engineering colleges of the country in accordance with the classification adopted."

With respect to (2) I may say that it was not our thought—as might be supposed from a reading of the paragraph—that the Engineering Council should rate engineering colleges at once, or before they had had time to respond to its suggestion as to what should constitute the proper training for college stutents of engineering in the different grades; but that some time after such suggestions had been made it would be entirely proper to rate these colleges.

We suggest the American Engineering Council rather than the Society for the Promotion of Engineering Education because we believe that the council would speak with more authority than the teachers can possibly have. It was the American Medical Association, not any group of college teachers of medicine, that made it possible to raise the standards of medical education, and we think that it is to the national societies of practising men that we must look for a demand to be made with authority.

WM. G. RAYMOND,
Dean, College of Applied Science, State University of Iowa.
Iowa City, July 18.

Sir—During the past two years a definite movement has been inaugurated to advance the prestige of the engineer through legislation. This effort has been fostered notably by one organization of engineers which itself is but a few years old. Reference is made to the registration and licensing laws that have now been passed by many states.

This movement may have been fostered by the overenthusiam of a newly organized body to accomplish in a short period what it takes many years of training to do. It is presumed that the elevating of the status of the engineer is one of the prime objects of the license law; for if this law was only designed to protect the life, health and property of the public there are existing, as Prof Geo. F. Swain has pointed out recently, adequate safeguards in the construction of buildings, public and private utilities, etc., through supervision by competent commissions and engineers, through building laws and other special laws requiring official supervision, approval of plans and inspection of work.

Furthermore a joint committee of engineers reported adversely to the passage of the engineers registration and

licensing law now before the Massachussetts Legislature, stating that there would be tendency through licensing to place the inexperienced man before the public on a plane with the experienced engineer of higher professional attainments.

Certainly this higher professional attainment cannot be obtained through any of the present registration laws; it is a matter which demands the serious consideration of the educators of our country, acting through an effective organization whose true vision is the development of an engineer who will have the fundamentals, the culture and the stamina worthy of the professions.

There are two types of engineering education; the usual four year college course and the professional engineering course requiring a science degree for entrance, with the former much more in evidence.

A graduate from the usual college course has had a training principally with materials of an inanimate nature and the laws and forces acting thereon. He has had little or nothing to do with the things of life and society. Only too often he looks upon his training bluntly as a means of future existence. As an engineer he makes an excellent tool and serves the public in an admirable way, although many times resting snugly in a predetermined niche. Such a man has been characterized as an applied scientist. This well fits Prof Burr's remarks about many engineering colleges.

The professional engineering course of six years produces men of higher attainments. The best professional spirit demands more than ever that a man must know something of foreign as well as domestic politics, of social problems (often called humanities) and an acquaintance with the world's best literature. Education of engineers for the new era must train and teach with all the vision possible and must instill in them a love for the profession which will carry with it the enthusiasm which has been characteristic of our engineers of highest attainments.

This type of training elevates and leads to lofty ideals, giving that refinement which is instantly noticeable.

Prof. Burr's outline of a six-year course is a highly pertinent topic and only by discussion and popularizing through an effective organization can the demand be created and progress made in the direction of a six-year course.

HARRY G. PAYROW,
Ass't. Prof. of Civil Engineering, Lehigh University.
Bethlehem, Pa., Aug. 2.

Sir—Prof. Burr's paper is timely and has opened for discussion a subject that has been given considerable attention by teachers and practicing engineers.

One point commonly overlooked is that the aim of our engineering schools and colleges (the name signifies little) in the undergraduate courses is largely to fit men for the business and industrial world. Those students who intend to follow engineering as a profession must either take graduate work or serve an apprenticeship under professional advice. Thus, engineering institutions are really trying to fit men for two types of life work, namely, that of the graduate who undertakes construction, drafting, sales, etc., and that of the truly professional man who goes into design or consulting work. One course can not be made to meet both conditions. Our present system serves its purpose well with the exception that the courses are often too highly specialized. Unfortunately, as Prof. Burr points out, the student who intends to enter the profession of engineering is handicapped by lack of instruction necessary to place him on a par with men of the other professions. His endeavors must be confined to graduate study which in many instances consists in doing senior work in greater detail. In addition to the present curricula, there should be scheduled six-year courses for those who intend to enter the profession. Only institutions well equipped to undertake graduate work should attempt to install the long courses and some distinction in the degree granted must be made. The number of applicants will be limited not because of financial inability nor lack of intelligence but because most of our students do not intend to enter the profession. Furthermore, the opportunities of the professional engineer are more limited in the amount of work to be done than are those of the lawyer or the physician. It is again a case of supply and demand.

The practice of lawyers and physicians is consulting work and when comparison is made with engineers such comparison should be limited to consulting engineers who represent the truly technical men. The standing of consulting engineers in a community is as high on the average as that of the members of any of the other professions.

Lafayette, Ind. F. W. GREVE,
July 29. Assoc. Prof. of Hydraulic Engineering,
Purdue University.

Foreign Practice in Bank Protection

Sir—The problem of bank protection, which appears to be of interest to your readers (see Letters to Editor in your issues of May 26 and July 14, 1921) was solved by European engineers early in the last century, and the Rhine, Rhone, Danube and Poe rivers afford excellent examples of the methods employed by them. French, German, English and Russian engineers have investigated the causes of bank erosion and published their conclusions. Your pages indicate that a text-book on the elementary principles of river hydraulics could be utilized by the engineers of the United States.

About 1838, M. Defontaine published his work "Des Travaux du Fleuve du Rhin" of which a portion has been translated and appears in Volume IX, "Memoirs of the Corps of Engineers, U. S. A." In this work he investigates the flow of water around impermeable dikes making various angles with the bank and finds that there is no relation between the angles of incidence and of reflection of flowing water, but that instead a very complicated eddy action is set up. On his diagrams he plots three eddy currents below the dikes, one flowing just below them with sufficient force to sometimes cause caving at a distance from the dike equal to two and one-half times the perpendicular distance of its end from the bank, a second striking the bank about five times the said perpendicular distance and a third moving diagonally toward the opposite bank. Between the first two currents a sand bar forms. Eddy action, above the dike, also deposits silt, but separated from the dike and river bank by a channel, which under certain conditions causes scour along both.

When the dikes are inclined downstream this scouring action is intensified and the deposit above the dike diminished. During high stages there is an overflow which directly impinges against the bank below causing caving and which is converted into an eddy action if the dikes incline upstream.

During the 18th century the Germans employed dikes inclining downstream very extensively, but with such disastrous results that they afterward connected the outer end of one dike to the inner end of the next, producing what was termed "Trianglewerke" (Jassmunds' "Die Arbeiten der Rheinstrom—Bauverwaltung"), but after the investigations of Profs. Hagen and Schlichting the dikes were given an inclination upstream. Modern French, Austrian and Italian practice is similar.

M. Defontaine proposed as a means of counteracting these injurious eddy currents to leave openings in the dikes through which a current could flow along the bank, but with a diminished velocity, which would induce the deposit of material held in suspension, instead of relying on material rolled along the river bed to create the fill. The permeable dike was then unknown and his method exhibited great ingenuity in utilizing the material he had at his disposal. With the introduction of permeable dikes of which the Retard described by Mr. Atwood in *Engineering News-Record*, July 14, 1921, is an excellent example, this deposition is readily accomplished. The permeable pile dikes constructed on the Missouri River work on the same principle. The Retard has, however, the advantage that it is not as easily damaged by floating ice and drift, since the branches of trees are not as rigid, as the tops of driven piles. On the Mississippi River, where permeable pile dikes have also been extensively employed, it is necessary to watch the accumulation of drift and to sink it in place with a mass of rock, before it assumes dangerous proportion.

Foreign text-books specify the space which should separate the dikes on a concave or convex bank or in straight reaches, but for the purpose of regulating the channel depth, rather than for bank protection. Nobilings, which are sloping submerged dikes, extensively employed for bank protection on the Rhine River, are separated by a distance equal to about twice their length. Where permeable dikes are employed this distance can be increased. The dikes on Indian Rivers quoted by Mr. Thackwell are intended for land reclination rather than bank protection. The intermediate dike could be omitted without endangering the original bank.

C. McD. TOWNSEND,
Colonel, U. S. A., Retired.

Brooklyn, N. Y., July 18.

Steel Lower

Sir—We are greatly interested in your editorial under the heading of "Steel Lower," as set forth on page 48 of the July 14 issue of *Engineering News-Record*.

With respect to that part of your paragraph wherein you cite the minimum of $1.08 reached in December, 1914: Without dwelling lengthily on this subject, we beg to advise that this minimum price only lasted for one week, and from that time on there was a steady advance. Furthermore, the writer was hiring men for $1.25 per 10-hour day. We were buying gas coal at the mines for $1 to $1.10, and we were getting a freight rate of $1.35. Office help was getting just about half the money they are now getting. We could get all the stenographers we wanted for $12 per week, and typists could be had at $5 per week, all of which had a bearing on the costs.

In order to bring the price of shapes down to 2c., we have got to cut labor to 25c. per hour. Office help has taken a cut of 25 per cent. In other words, for a man today to make $15 per week, he has got to work 60 hours, and you can see whether a man can pay rent, keep a family, have medical attendance, pay insurance, and then have some one of our economists tell him that he must save for a "rainy day." There has been no decline in rents, and there will not be. Meats are not any cheaper, and not only that, but foodstuffs are beginning to advance in price. The worst of it is that men can't get six days of work per week at the present time, and their condition is beginning to become pitiful, especially in small towns where other employment is scarce.

You know how much chance there is of reducing freight rates to the old levels. To do so you have to cut the rest of the organized brotherhoods of the railroads, and they are too well intrenched and fortified, by law as well as by financial strength, to take any substantial reduction except over a period of time.

If you were out selling the material you would find that it is not so much the cost of material that is holding up the jobs as the fact that projects cannot be financed at a reasonable rate of interest.

Going back to December, 1914, you will find that the mills were only working a few days a week, and this is indicative of the present condition. We have reached a higher price level in this country, and the people have become accustomed to a higher standard of living, and the conditions are such that there can be no recession to the prices back in 1914, to which the economists so delight to refer.

One of the troubles in writing editorials is the fact that the man simply deals with the subject from a superficial standpoint rather than having a thorough knowledge and insight into the trade about which he is writing. It is just such editorials as these that are doing incalculable harm to the building business, as well as the other industries.

CHEMUNG IRON & STEEL COMPANY,
Per E. F. Quirke.

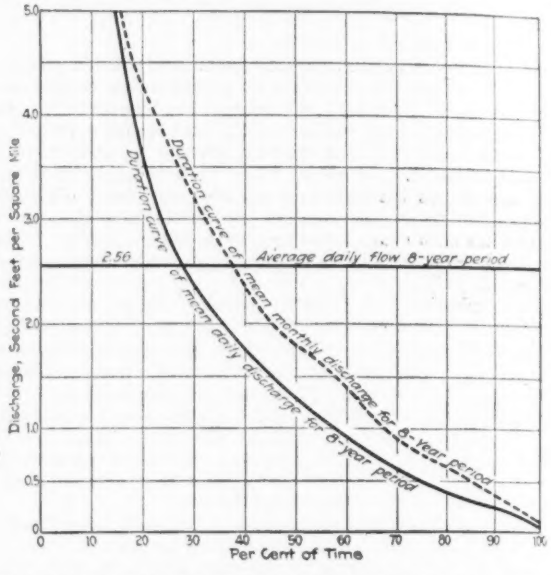
New York City, July 15, 1921.

[Mr. Quirke makes his argument on production cost. Regarding that the editorial in question said, "Probably under existing conditions of low demand, the bottom level will be determined less by production cost than by the confidence of the industrial world in the soundness of the schedule." It is not what costs are but what the public thinks they ought to be that will stimulate buying.—EDITOR.]

The Time Units in Flow-Duration Curves

Sir—In the various methods of estimating the water power available at a particular site the flow-duration curve seems to be quite generally used, especially in the East. It has been noticed in various reports of private engineers and in some state reports that in constructing duration curves of flow there seems to be a general tendency to use the month as the time unit instead of the day and that this always gives higher values than would result if daily flow data were used.

If the mean daily flows for each month were uniform there would be no difference in the curve made up from mean monthly flows or mean daily flows, but in most rivers



FLOW-DURATION CURVE, PISCATAQUIS RIVER, FOR EIGHT YEARS ENDING SEPT. 30, 1920
At a point near Foxcroft, Me.; drainage area, 286 square miles.

for several months in the year there is a wide variation between the average flow for the month and the highest and lowest average daily flows in that month.

The accompanying diagram shows the difference between the duration curves of mean monthly discharge and mean daily discharge for a river in Maine. In picking off the discharge for 90 and 60 per cent of time, which might be used as the limits of primary and secondary power respectively, the following wide difference is shown:

Per Cent of Time	Discharge in Second Feet per Square Mile from Monthly Curve	Discharge in Second Feet per Square Mile from Daily Curve	Value from Monthly Curve Larger Than Value from Daily Curve by Per Cent
90	0.42	0.24	75.0
60	1.40	0.91	53.8

While this particular stream is of the flashy type and the difference between the curves is large, the difference between similar curves for a stream under practically complete regulation would be small.

There seems to be a general tendency, however, to use the month as the unit of time for most any type of stream. Can this be because it is easier, or, is it believed that the error incurred by using monthly averages will disappear in using and compiling resulting data?

M. R. STACKPOLE,
Assistant Engineer, Maine Water Power Commission.

Augusta, Me., July 7.

Meters and Water Consumption at Providence

With 94 per cent of the services metered the water consumption at Providence, R. I., in 1920 was 80 gal. per inhabitant. Practically all the 270,472 population of the district supplied takes water from the system.

HINTS FOR THE CONTRACTOR

Whitewash Prevents Asphalt from Running Under Summer Sun

SO CLOSE to the melting point is the asphalt waterproofing coat on the top and side walls of the Galveston causeway that a coat of whitewash will prevent the paint coat from running. The views shown were taken during the inspection trip of the American Society of Civil Engineers at the time of the Houston meeting.

LEFT—APPLYING WHITEWASH TO THE SIDE WALL
RIGHT—SLIGHTLY THICKER COAT AT BURLAP STRIP RUNS

Guesses as to what "Uncle Tom" was applying, and why, ranged from a chemical hardener to a "dolling" up of the job for inspection. The explanation of Mr. Washington, engineer in charge, that white absorbs less heat rays than black and further that the difference was enough to prevent melting, seemed too simple. Where the thickness is increased as at a burlap patch, the extra body of asphalt absorbs enough heat to melt the mass.

Depot Footway Built in Quick Time

TO CONNECT the concourse of the Union Station, Chicago, with a cab yard half-a-block distant, it was recently necessary to build a footway 12 ft. wide and 160 ft. long as a sunken way because of the congestion and dense traffic in the narrow street above. The work was carried out quickly and conveniently, partly as a tunneling operation and partly, by dropping into an excavation a cribwork assembled on the surface.

First, a building opposite the station was jacked up the height of one story and the basement made a part of the footway, the sidewalk being tunneled and an open incline extended to the cab yard in the rear. The station sidewalk was also tunneled from the concourse.

Half of the 48-ft. roadway was closed for a short distance, the paving being then removed and a locomotive crane on traction wheels brought in to excavate a trench with a ½-yd. clamshell bucket. The earth was removed in motor trucks, there being no room for storage. A crib already assembled in sections was then hauled in by trucks, lowered into the trench and sheeted. Material for backfilling was brought in by trucks and the paving was then laid. The same operations were repeated on the other half of the street No concrete was used, as this footway is only a temporary expedient for use until the new station now under way is completed.

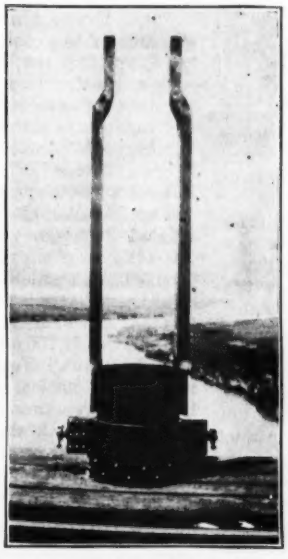
The entire work in the 48-ft. roadway was done in eleven days, the east half occupying only four days. This footway was designed under the direction of J. D'Esposito, chief engineer of the Chicago Union Station Co., and was built by the W. J. Newman Co.

Universal Knuckle Allows Piledriving With Leads in Any Position

BY M. L. VAIL
Inspector of Construction, Brann & Stuart, Philadelphia, Pa.

IN THE RENEWAL of a bridge on the New York & Long Branch R.R. over Shark River, N. J., it was necessary to remove all of the old piles that had been driven in previous years. This was to be accomplished by pulling or driving the old piles down with the aid of a follower 5 ft. below the bed of the stream. The majority of the piles were pulled but those upon which it was impossible to fasten a wire sling were driven down after the new bridge was built.

To drive these old piles down under the new bridge required much time and effort to center the leads. The hammer used was a 5-ton steam hammer suspended from a 50-ft. steel boom in 50-ft. leads. A derrick car of 50-ton capacity carried the piledriver.



UNIVERSAL-PILE-LEAD KNUCKLE

In order to overcome the delay of re-reaving the steam hammer after each change in the line of piles, John O. Fetter, superintendent for the Brann & Stuart Co., Philadelphia, who had the contract for doing the work, designed and had fabricated a universal-pile-lead knuckle which would allow the hammer falls to work freely under any position of the leads and at the same time the leads could be turned in any position for the driving of plumb and batter piles. The knuckle was constructed of two ¾-in. x 10-in. channels 9 ft. long, bolted to a wrought-iron pipe 30 in. in diameter and 30 in. long. At the bottom of the pipe was riveted a band of 1½-in. x 4-in. iron. This band acted as a seat for the segmental clamps, containing the two trunnions which carried the leads, to turn upon. The channels were bored to take the pin at the outer end of the boom, the knuckle hanging as a unit and sustaining only the weight of the leads, the hammer and falls hanging clear.

The turning of the leads was accomplished by three men. No steam line was required. The knuckle was used under all conditions. Tests first were conducted on shore in driving plumb batter piles, as well as the driving down of old piles with a follower. The performance of the knuckle was entirely satisfactory. The knuckle could be used from any style boom capable of holding pile leads with the same satisfactory results.

NEWS OF THE WEEK

New York, August 11, 1921

Upham Outlines $50,000,000 Road Program for N. C.

Local Material Survey in Progress—Scenic Highways a Feature—400 Miles the First Year

(Special Correspondence)

Charles M. Upham, the new chief engineer of the North Carolina Highway Commission, has given to a correspondent of *Engineering News-Record*, who is making trips with Mr. Upham in the field, an outline of some of his plans for highway construction, improvement and maintenance in that state, which has authorized a bond issue of $50,000,000 for highway improvement, in addition to the money that may be spent on such work by the counties and as the result of federal aid. Mr. Upham foresees no difficulties in carrying out the proposed highway program of North Carolina, beyond, first, developing and using the supply of local materials, and, second, overcoming the lack of sufficient trained highway engineers. It is planned to include in the program scenic highways through the Blue Ridge Mountains.

"I find that North Carolina has about 6,000 miles of roadways of all kinds," Mr. Upham said, "these roadways ranging from mountain trails of earth to modern asphalt or concrete highways. We estimate, and will attempt a program based on it, that we will construct, for the first year, 400 miles of new hard surface roads of improved type, consisting of macadam, concrete and bituminous construction, or combinations of these, and that we shall construct 500 miles in each succeeding year. I cannot make any estimate at this time of the earth roads to be constructed. This construction may run as much as the new hard surface roads.

Materials Survey

"One of the most most important things to be done at once—and we have begun on it—is to make a material survey of the state. We must find larger sources of supply than are now available of stone, gravel and sand, suitable for road building. At present, there are few commercial developments of these, but these sources must be tripled, even quadrupled, before they can begin to supply the demand we shall make for carrying out our large program. As to the supply of suitable labor, there seems to be an abundance at present."

Mr. Upham sees an opportunity for the North Carolina highway department to work with the colleges in their summer courses, taking their graduates as inspectors and engineers.

One good thing about the highway building program in North Carolina, it is pointed out, is the lack of excessive frost. Then, too, the state regulation of motor trucks means that the system of highways will not be obliged to carry the excessive loads found in and near the larger northern cities, for the North Carolina statutes prohibit the use of trucks heavier than 7½ tons, including weight of both vehicle and load.

Ridgway to Study Urban Transit in Europe

Robert Ridgway, chief engineer of the New York Transit Commission, has been directed by that body to visit Europe for the purpose of studying urban transit construction and conditions and to submit a report of his observations on his return to New York City. He plans to sail on the "Olympic," Aug. 13, and will visit London, Glasgow, Hamburg, Berlin and Paris. The trip will require about six weeks.

On the outgoing transatlantic trip Mr. Ridgway will have as a fellow passenger, Clifford M. Holland, chief engineer of the New York-New Jersey Tunnel Commission who has been authorized to investigate vehicular tunnels abroad.

Begin Construction Surveys for Philadelphia Bridge

Funds having been made available by all three of the communities participating in building the Philadelphia-Camden bridge, construction surveys have been started. A preliminary triangulation and real estate surveys are being made, in charge of Assistant Engineer John Briggs, formerly of the Philadelphia Bureau of Surveys.

The Philadelphia Council has appropriated $500,000, which, together with the balance of a prior appropriation of $250,000, is available to apply on real estate purchases and substructure contracts. Of Pennsylvania state funds, the sum of $1,750,000 is now available, and of the total New Jersey appropriation of $28,000,000 (to cover both the Hudson River tunnel and the Camden bridge), as much as may be required is at the disposal of the commission.

Daniel E. Moran, of Mendham, N. J., has been appointed consulting engineer on foundations on a fee of $10,000 per year. Rapid progress is being made with plans for the main piers and anchorages, and at the same time a complete review of the entire design project has been started as a check on the preliminary design.

To Discuss Snow Removal

Snow removal methods will form the main topic of discussion at the meeting of the metropolitan section of the American Society of Mechanical Engineers to be held in the Engineering Societies Building, New York City Sept. 23.

New York City Rules Against Foreign Pier Machinery

Board of Estimate Decides Staten Island Port Development Must Have American Machinery.

On Aug. 2 the Board of Estimate and Apportionment of the City of New York by a unanimous vote decided that the advertisements for bids for cranes, elevators and electric power transmission plants on piers 12 and 13 of the new port development at Stapleton, Staten Island, shall specify that the machinery be of American manufacture. This is the culmination of a controversy which has had little public notice but which has been under way for some time.

The City of New York is building on Staten Island a number of shipping piers which have been leased for long terms to various steamship companies. Piers 12 and 13, the largest of the group, have been leased to the Pan-American Terminal & Dock Corporation, an American corporation but one which is reported to be made up largely of foreign interests and shipping people who have operated mainly in foreign ports. All of the lessees were permitted large powers of alteration of the various designs of the piers and the lessees of piers 12 and 13 asked and were granted a two-story, wide pier design in which a great amount of handling machinery was provided. The principal units of this machinery were thirty-four cargo cranes of a unit value of $10,000 to $15,000.

Discussion Over Specifications

Specifications for these cranes were submitted some weeks ago by the Dock Department to the Board of Estimate, which is required by law to see such specifications and to authorize their advertising. Prior to the submission to the Board of Estimate of the specifications a number of the material handling machinery manufacturers of the United States went before the dock commissioner with a plea that the specifications be written in such form as to preclude the awarding of the bids to foreign bidders. They claimed that the specifications then about to be advertised were prepared mainly by the lessee and that its experience and predilection led it to favor foreign designs in the specifications. Furthermore, these manufacturers stated that owing to the very low labor cost abroad, particularly in Germany, and to the adverse exchange, again particularly against Germany, European countries could put in bids on these specifications radically lower than any American manufacturer could meet. It was contended that while the lowest American bid might be $500,000, Ger-

man manufactures could—and furthermore were prepared to—bid on machines which would meet the specifications at a cost to the city of about $400,000.

The American manufacturers further claimed that the foreign cranes which might meet the specifications would have details peculiar to foreign practice and would not only be of shorter life than American made cranes but would be difficult of operation by American labor and extremely difficult of repair when the extra parts furnished under the bid had run out. They further contended that the situation at present which would permit so much lower bids by Europeans is only temporary and that the foreigners could not hope to hold the American market. They, therefore, would be under no incentive to do other than to furnish a machine which would pass the specifications and would care little whether it would stand up under service because they would not hope to get future business. They pointed out, too, that little, if any, work of this character was under way in American shops and that the $500,000 award would mean giving work to a number of idle American workmen.

All these arguments were later brought before the Board of Estimate with the result above noted. Neither the specifications nor the advertisement under them, have yet been made public.

Labor Elections of P. R.R. Held Illegal by Rail Board

Recent elections of employees' committees held by the Pennsylvania R.R. were declared illegal and void by the Railroad Labor Board in a decision rendered July 31. The decision also ordered a new ballot to select a committee to negotiate rules to supercede the national agreements of federal control. The railroad had refused to negotiate with the labor unions directly in the matter of working out revised agreements and subsequently held a ballot vote to select individuals for employees' committees without provision for organization representation. The union men issued a ballot of their own which the railroad again refused to recognize. In making the decision the labor board said: "The carrier had no more right to undertake to assume control of the selection of representatives of the employees than the employees would have had in supervising the naming of the carrier representatives. In this sophisticated land of popular elections, no political party would submit it having its primary held and managed by the oppsing party."

In the meantime petitions had been presented by four industrial associations to appear before the Railroad Labor Board in behalf of the public, and in support of the open shop policy of the Pennsylvania R.R. The petitions are from the National Association of Manufacturers, the National Founders' Association, the National Erectors' Association, and the Employers' Association of Chicago.

A. A. A. Objects to Further Motor Vehicle Taxes

Summarizing the opposition of the American Automobile Association to any further taxation of motor vehicles, with the reasons therefor, President George C. Diehl has authorized for publication a statement from which the following extracts have been taken:

"There are today some 10,000,000 motor vehicles in the United States of which approximately 1,000,000 are motor trucks. According to data prepared by the U. S. Bureau of Public Roads one man in every eleven owns a motor vehicle. These 10,000,000 owners are now paying several separate and distinct taxes aggregating $348,878,878 or $34.67 per car, detailed as follows:

Federal excise tax, passenger cars, 1920	$83,600,294
Federal excise tax, motor trucks, 1920	15,160,456
Federal excise tax, parts, accessories, tires	49,960,128
Federal registration vehicles for hire	2,049,000
State motor vehicle registration fees	102,000,000
Personal property taxes	75,000,000
State motor fuel, franchise, mileage, business, etc.	10,000,000
Local motor fuel, franchise, mileage, business, etc.	10,000,000
Municipal registration and license fees	1,000,000
Total	$348,769,878

"Fundamentally, the motor vehicle is an element in transportation and if, as Secretary of the Treasury Mellon has indicated, we should repeal or cut down transportation taxes, then certainly the burden of this factor in highway transportation, which last year was estimated to have hauled more than 1,000,000,000 tons of freight and carried almost 5,000,000,000 passengers, is entitled to the same consideration as the older agencies. Railroad and water operation is dependent upon delivery of the load. Highway transport is the indispensable link in the chain.

"It is unnecessary to indicate how deeply the motor vehicle has penetrated into farm life. It is enough to say that 72 per cent of all cars are sold in towns having a population of 50,000 or less, 55 per cent in towns of 5,000 or less and 33 per cent in towns and hamlets of 1,000 or less. Approximately 66 per cent of all passenger cars are owned and operated by men having an income of $4,000 or less.

"Today the entire cost of construction and maintenance of state highways or of state bonds for road improvement is levied against the motor vehicle in many states. The pre-emption of this source of revenue by the states would be immediately interfered with by any further federal tax and would cause a strong and reasoned protest by state legislatures who already see many of their earlier sources of revenue taken over by the government. It is true that the federal government, wisely we believe, has aided the states in road building, but it would be as fallacious for the nation to tax the motor vehicle for road construction as for the states to do so, particularly in view of what President Harding has termed 'a shocking waste' in the lack of adequate funds for road maintenance."

Senate Committee Busy on Townsend Bill Changes

Action Desired Before Congress Takes Recess — Appropriations Are Discussed

Washington Correspondence

The Senate committee on post offices and post roads is working actively on amendments to the Townsend bill, with the idea of making it more acceptable to the Senate and to the House. It practically has been decided to take the bill which passed the House and strike out all after the enacting clause and insert as a substitute the Townsend in its amended form. Work has not been completed on the amendments at this writing, but it is expected that the amended bill will be reported out of committee during the latter part of the week ending Aug. 13. Every effort will be made to get the bill out before the Senate takes a recess. No changes will be made in the provision of the Townsend bill, which call for a federal highway commission and an interstate system of roads, it is understood.

An attempt will be made to amend the bill so that it will be unnecessary for any state to change its constitution before it would be able to participate in federal highway funds. As each of the bills stand today, constitutional changes would be necessitated in Texas, Arkansas, South Carolina, and Alabama. It is probable that the provision detailing military officers to the highway commission will be eliminated by the committee.

Appropriation Discussed

There has been considerable discussion in the committe as to what appropriation should be recommended. Some favor an amount less than the $400,000,000 authorized in the Townsend bill. The probabilities are, however, that the committee will make no change in the proposed $100,000,000 a year program.

The recess which Congress is about to take is expected to expedite highway legislation and improve the chance of securing the appropriation. This is based on the assumption that the public is determined that nothing shall interfere with the progress of highway construction and that this sentiment will become so evident to the legislators when they have an opportunity to mingle with the people of their respective states, that they will return to Washington convinced of the public demand for highway legislation.

Unless there is legislation, New Hampshire, Utah and Nevada will not be able to construct a mile of highway next year. Twenty-six states now have all of their apportionment of federal funds under contract or will have the entire amount under contract before the end of the year. In the case of nine other states, there will be only small balances after the end of the year.

Scale of Fees Proposed in Federal Motor-Vehicle Bill

That portion of the Appleby bill, introduced in the House of Representatives July 28, as noted in last week's issue, specifying the amounts of the proposed federal tax on motor vehicles, in addition to existing state taxes, is as follows:

"Forty cents per horsepower or fraction thereof in the case of all vehicles having pneumatic tires, with a minimum charge of $5 for any motor vehicle. For each motor vehicle equipped with solid tires and having a rated carrying capacity of not more than 1 ton, $10; of not more than 2 tons, $20; of not more than 3 tons, $30; of not more than 4 tons, $40; of not more than 5 tons, $50; of not more than 6 tons, $60; of not more than 7 tons, $70."

Trailers of 1 ton or less capacity are taxed $5, with provision of an additional $5 for each additional ton of capacity. The administration of the proposed act is vested in the U. S. Bureau of Public Roads.

Whether or not Representative Appleby will be able to secure consideration of his bill proposing a federal license for the convenience of motorists in interstate travel will depend largely upon the action of the House Ways and Means committee on the proposal by the Secretary of the Treasury that there be a flat federal motor vehicle license tax of $10.

Conference on Highway Transport Education Meets

"Highway transport now involves a total capital investment in excess of that of the railroads while the annual operating charge is nearly as large as that of the rail carriers," declared Roy D. Chapin, chairman of the highways committee of the National Automobile Chamber of Commerce at a conference on highway transport education held at the University of Maryland July 29. The meeting was called by the national committee on highway and highway transport education, of which Prof. C. J. Tilden, is director, to outline the most pressing phases of this subject for study and research in the colleges, universities and other agencies interested. Charles S. Howe, president of the Case School of Applied Science, presided.

A general outline of the problem was given by Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, who said that many of the states are approaching the limit of highway bond issue financing under their present laws and called attention to the need for a further extension in order to facilitate what he termed a most needed development.

L. M. Estabrook, assistant director of the bureau of markets and crop estimates of the Department of Agriculture, said that 153,400,000 tons of farm produce were transported over highways to the railroads annually and that additional thousands of tons are carried on the highways which never reach the rail denoting the need for improved highways.

Prof. W. K. Hatt, of the National Research Council, and Prof. J. G. McKay, University of Wisconsin, outlined constructive programs for research into highway finance, valuation, transportation, administration, construction, maintenance and legislation.

Indiana Engineer Registration Board Named

Governor McCray of Indiana has appointed the new state board for the registration and examination of engineers, one of the boards created by the last Legislature. The appointees, together with the length of time they will serve, follow: Ray Seeley, Hammond, three years; Clyde A. Walb, Lagrange, two years; Harvey Michael Anthony, Muncie, two years; Charles W. Cole, South Bend, one year, and Prof. R. L. McCormick, of the Rose Polytechnic Institute, Terre Haute, one year. The members of the board are paid a salary of $10 per diem. One member of the board will be designated to act as secretary. The law prescribes certain qualifications for engineers and specifies a fee of $25 for registration and license.

Congress Authorizes the Port of New York Compact

Congressional approval has been granted the compact between the States of New York and New Jersey, constituting the Port of New York Authority, by the action of the Senate, Aug. 5, 1921, in adopting the House resolution. The text of the resolution is as follows:

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the consent of the Congress is hereby granted to the States of New York and New Jersey to enter into the agreement for the establishment of "the port of New York Authority" for the comprehensive development of the Port of New York, pursuant to chapter 154 of the Laws of New York, 1921, and chapter 151 of the Laws of New Jersey, 1921: Provided, That nothing in this resolution shall be construed as waiving or surrendering any right now vested in the Federal Government.

Sec. 2. That the right to alter, amend, or repeal this resolution is hereby expressly reserved.

Ford to Operate Own Barges on New York State Canal

Announcement was made in New York City Aug. 1, by Gaston Plantiff, Henry Ford's eastern representative, that the Ford company is preparing to put into operation at an early date a fleet of barges to transport the materials and products of the Ford plants between Detroit, Troy, N. Y., and the port of New York. The plan has been considered for some time in connection with the recent completion of the Ford assembly plant at Kearney, N. J., and the plant now building at Troy. The barges will be propelled by internal combustion engines. They will have a capacity of 1,000 tons and will be 150 ft. long with 20-ft. beam.

Engineers Appointed for N. Y. Harbor Tunnel

Jesse B. Snow, of Vehicle Tunnel Staff, becomes Engineer in Charge—Wilgus and Sullivan, consultants.

A nucleus of the organization which will have charge of the projected freight and passenger tunnel under New York Harbor between Staten Island and Brooklyn was created last week when the Board of Estimate and Apportionment of New York City approved the appointment of Jesse B. Snow as tunnel engineer at a salary of $12,000 a year and of Col. W. J. Wilgus and John F. Sullivan as consulting engineers, each at a salary of $10,000 a year. The board also confirmed the selection of Charles B. Drew at $7,500 a year as principal assistant engineer. All of the foregoing appointments, except that of Mr. Sullivan, follows the recommendation of Arthur S. Tuttle, chief engineer of the Board of Estimate, who will be in general direction of the tunnel project. Mr. Tuttle had proposed the name of Frederick C. Noble as one of the two consulting engineers, but the board failed to act on this recommendation.

In becoming the engineering head in responsible charge of the proposed tunnel, Mr. Snow gives up his present work as principal assistant to Clifford B. Holland, chief engineer to the New York-New Jersey Tunnel Commissions on the Hudson River vehicular tubes. Mr. Snow was graduated from Union College with the degree of C. E. in 1889, and his early professional experience covered a number of years on municipal work, including paving, water supply and sewerage in a numer of cities in New York and Pennsylvania.

Snow's Tunnel Experience

In May 1900 he became resident engineer in charge of 10 miles of single-track construction on the Jamestown, Chautauqua & Lake Erie Ry., and two years later was appointed chief engineer of the Jersey Central Traction Co., on electric railway construction. After being engaged on surveys for the Tennessee Power Co., in 1905, he began his experience in subaqueous tunneling with an appointment, in 1905, as inspector on the East River tunnels of the Pennsylvania Railroad in New York City. He was promoted through the various grades until he became principal assistant to the resident engineer, in which capacity he continued throughout the period of the Pennsylvania tunnel construction.

Beginning in July 1910 Mr. Snow served as engineer and assistant superintendent for the Foundation Co. on the reconstruction of the Hauser Lake dam in Montana by means of a caisson cofferdam, and in 1911 became engineer for the Canada Syndicate of surveys for hydro-electric power development. He remained with this organization until 1914 when he was appointed resident engineer with the Public Service Commission of New York on the construc-

tion of the subway tunnels under the East River, later becoming principal assistant to Mr. Holland, then tunnel engineer for the commission.

When the engineering organization for the Hudson River vehicular tunnels was being formed in 1919 the chief engineer chose his former associate to serve as principal assistant. Mr. Snow has been with the New York-New Jersey Tunnel Commissions since 1919.

Mr. Tuttle has announced that conferences have already begun between the City of New York and executives of the railway companies involved in the tunnel project.

Pittsburgh to Build Concrete Bridge

Plans are being prepared by the Department of Public Works of Pittsburgh, for a reinforced-concrete bridge on Beechwood Boulevard, over Forward Ave. The old timber structure which made the crossing, 555 ft. long, with maximum height 125 ft. above Forward Ave., collapsed on June 18, two days before its removal was to be begun. The old structure had been condemned a year ago and closed to vehicular traffic, and on June 11, of the present year, it was closed to pedestrian traffic. The new reinforced-concrete structure should be under contract within a month.

Increases in Sight for Patent Office Personnel

The bill providing for an increase of force and salaries in the U. S. Patent Office has been reported out by the House committee on patents with the recommendation that it be passed at the earliest possible date. The bill increases the salaries of the principal examiners in the Patent Office from $2,700 to $3,900 per year. Assistant examiners are allowed increases ranging from $150 per year to $900 per year. The bill also increases the commissioner's salary from $5,000 to $6,000.

The demoralized condition of the Patent Office may be understood when it is known that there are now 46,472 applications awaiting attention. The number of pending applications is increasing all the time. In a little over a year, 110 examiners—one-fourth of the total examining force—have resigned. These men were experienced examiners, with from 2 to 20 years' training. Their places have been taken by young men just out of college—the only ones apparently to whom the salaries appeal.

Clark Resigns From Interstate Commerce Commission

Chairman Edgar E. Clark, of the Interstate Commerce Commission, has resigned from that body and will enter the private practice of law. To fill the vacancy caused by his resignation, the President has nominated Frederick I. Cox, of New Jersey, as a member of the commission.

Federation Has 27 Members

Including the three organizations elected to membership at the meeting of the executive board of the American Engineering Council in St. Louis, June 3. there are now twenty-seven member organizations of the Federated American Engineering Societies. Two additional applications are now pending. As a result of the efforts of members of the council, other engineering organizations have the question of joining the federation under consideration and in several cases are now in the process of voting.

According to a recent statement by L. W. Wallace, executive secretary of the federation, the council is actively at work advancing the plans for a national department of public works, helping improve the status of public health engineers, obtaining equitable engineering research legislation, co-operating with the American Engineering Standards Committee, working for the appointment of engineers to engineering positions in the federal government and supporting the topographic mapping program. A special employment committee has under consideration a definite plan for improvement and extension of the service, whereby it is contemplated that special arrangements will be made to care for the interest of constitutents of member organizations in the present employment crisis.

The special committee on licensing has been directed to hold a hearing for the purpose of further reviewing and perfecting the model law so as to meet all requirements. This is to be done prior to the next meeting of council, but no definite date has been set.

The American engineering congress committee is at work planning for the engineering congress which is to be held in connection with the annual meeting of the American Engineering Council.

Timber Columns To Be Tested

For a series of tests to determine the effect of density and such defects as knots, checks and cross-grain on the strength of structural columns, forty southern pine timbers 12x12 in., 24 ft. long, have been selected by D. H. Holtman, construction engineer of the National Lumber Manufacturers' Association, and J. A. Newlin, of the U. S. Forest Products Laboratory. Half of the timbers were selected in Texas and the others in Alabama and Mississippi. Similar tests are to be made on Douglas fir columns.

Rea Joined P. R.R. 50 Years Ago

Samuel Rea, president of the Pennsylvania R. R., celebrated last month the fiftieth anniversary of his association with the railroad. He entered the service of the Pennsylvania as a rodman in 1871 and was promoted through the various grades of the engineering department until in 1899 he was appointed fourth vice-president. Mr. Rea became president of the road in 1912, succeeding James McCrea.

Data on Foundation Settlement Wanted

In a call for information just issued by the special committee on bearing value of soils of the American Society of Civil Engineers (R. A. Cummings, ch.) data are requested on settlement of foundations and of foundation soils in tests. The committee desires to secure statistical material bearing on the recommendations made in its last annual report, to the effect that the limit of allowable loading on foundation soils should be based on some definite portion of that part of the compression diagram showing a practically uniform rate of compression with increase of load. A question sheet has been prepared covering items of desired information. Copies may be obtained from E. G. Haines, 49 Lafayette St., New York, to whom the data should also be sent.

Graphic Reproduction by Wireless

Facsimile reproduction of a written document by wireless from New York to Paris was accomplished Aug. 4, when a message, written by C. V. Van Anda, managing editor of the New York *Times*, addressed to *Le Matin*, was successfully transmitted in seven minutes. The trial was carried out by applying the Belinograph to wireless. This instrument has been used for some time for transmitting autographic messages and photographs by wire. Dr. Belin, inventor of the instrument, declared that it would soon be possible to transmit photographs by wireless from one side of the Atlantic to the other.

$13,500,000 Hetch Hetchy Bonds Sold to Complete First Unit

The Construction Company of North America, which holds the contract for tunnel work in the mountain division of the Hetch Hetchy project, purchased $13,500,000 worth of 4½ per cent Hetch Hetchy bonds on Aug. 1. The bonds were bought at a discount which, by standard tables, puts them on a 5½ per cent basis, but they yielded a premium of $10,000. Earlier offerings at 4½ per cent, at par, brought no bids, so a charter amendment was secured permitting sale below par. The company also secured an option until Nov. 1, 1921, on an additional $8,520,000 worth of the same bonds on the same basis.

This sale of bonds makes available sufficient funds with which to complete the 18 miles of tunnel from Early Intake to Priest, the earth fill dam at Priest, penstock from that point to the Moccasin Creek power house and also for the construction of the power house and the equipment to be installed in it. When the tunnel work is completed, which is expected to be about June, 1923, water will be available for the development of power and 66,000 hp. is to be ready for delivery by the end of 1923.

If the option on additional bonds is taken up, funds therefrom are to be used to finance work on the project in the bay and peninsular divisions which are the next logical steps.

Kansas City Engineers Club Severs Association With A. A. E.

By a letter ballot recently taken the Kansas City Engineers Club has decided to withdraw from its affiliation with the American Association of Engineers. Steps have already been taken for the establishment of a chapter of the A. A. E. in Kansas City, as the withdrawal of the engineers club leaves the A. A. E. unrepresented in that city.

A Second Garbage-Feeding Contract at Los Angeles

Because of opposition to the location of a hog ranch at two proposed sites in Los Angeles County and due to an ordinance passed by the County Board of Supervisors forbidding the hauling and feeding of garbage to hogs outside the limits of any city within the county, G. W. Whitman notified the City Council of Los Angeles, on July 30, that he was unable to carry out the hog-feeding contract outlined in *Engineering News-Record*, July 14, p. 81. Subsequently the council voted to accept an offer from the Farmsland Co. for a ten-year contract at 60c. per ton, effective Sept. 10. The offer was accompanied by a $10,000 certified check and by a proposal to file a $75,000 guarantee bond. Application will be made for an amendment to the ordinance already mentioned, so garbage may be transported in closed steel cars to the contractor's hog ranch in San Bernardino County, where 5,000 hogs have been kept and where the contractor says 20,000 hogs can be in readiness by Sept. 10.

The city has made a temporary agreement with the Pacific Reduction Co., whose plant had been ordered closed Aug. 1, to continue disposal of the garbage by reduction. This company contracted some years ago to pay the city 51c. per ton for garbage delivered to a central point, but claims that it has been operating at a loss of late. Under the Whitman contract the city was to have been paid 96c. a ton for its garbage for ten years. Mr. Whitman first proposed to locate a hog-feeding plant near Montebello and then on land near El Monte and Baldwin Park, used for similar purposes before the reduction works were abandoned because of opposition and alleged menace to health.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Bridgeport, Conn., Sept. 13-16.

The Western Society of Engineers has elected the following officers: President, Charles H. MacDowell; vice-presidents, Julius L. Hecht, F. F. Fowle and B. S. Shapiro; treasurer, Homer E. Niess.

The Texas Road Builders' Association, at its semi-anuual meeting in Austin, July 20, appointed the following committee to consult with the state highway department, the University of Texas and the Texas Agricultural and Mechanical College, in order to broaden the scope of research work and secure proper appropriations therefor: H. C. Koch, chairman; E. Eikel and M. C. Welborn. The association appropriated $200 from the treasury for the purchase of a gift for T. H. Webb, whose resignation as secretary-treasurer was announced.

PERSONAL NOTES

ROBERT. S. PLUMB, formerly with the Lines Flynn Co., New York, is now connected with the J. P. White Co., Passaic, N. J., contractors, in charge of the purchase and sale of construction equipment.

P. C. PAINTER, city engineer of Washington, N. C., has been elected city manager of Greensboro, N. C.

H. M. RIGHTER has been appointed division engineer, Erie R. R., with headquarters at Susquehanna, Pa., succeeding Charles M. Lewis.

C. M. STAPLES, previously assistant to the corporate engineer, Southern Pacific Co., with headquarters at San Francisco, Cal., has been appointed division engineer of the Houston division at San Antonio, Tex.

C. W. H. RONDEAU of Westmount, Que., has been elected president of the Union of Canadian Municipalities.

DR. ROBERT J. ALEY, former superintendent of public instruction in Indiana, and for eleven years president of the University of Maine, has accepted the presidency of Butler College, effective Sept. 1.

EDWARD H. MAIER, formerly civil engineer for the Seabrook Farms Co., Bridgeton, N. J., has been appointed city engineer of Bridgeton.

SNOWDEN ASHFORD, for 26 years municipal architect for the District of Columbia, has become associated with Carroll Beale, civil engineer, Washington, D. C., where they will engage in the design and construction of fireproof buildings, under the firm name of the Beale Co.

CHARLES E. WADDELL, of Asheville, N. C., has been appointed chairman of the North Carolina state board of registration for engineers and surveyors created by the last legislature.

ROBERT J. MARONEY, assistant secretary and assistant treasurer of the Chicago, Milwaukee & St. Paul Ry., with headquarters in New York City, has been elected vice-president, succeeding G. G. Mason, resigned. He will continue to serve as assistant secretary and asistant treasurer in addition to his duties as vice-president.

H. W. COLEMAN, formerly superintendent of the water and sewer departments, Greenville, Miss., has been appointed city engineer and superintendent of streets, Albany, Ga.

C. M. COOPER, for many years county engineer of Cherokee County, Kan., and at one time city engineer of Columbus, Kan., has been appointed county engineer of Crawford County, Kan.

OBITUARY

J. G. SING, consulting engineer of Toronto, Ont., died in Medford, Ont., July 29. He was 64 years of age. Early in his career he entered the service of the Dominion Government and served for ten years as district engineer, Canadian Public Works Department, Toronto, Ont. He was also consulting engineer of the Toronto Harbor Commission and supervised harbor improvements in eastern and northern Ontario, including practically all the water front of the Great Lakes. In 1914 he resigned from the government service to engage in private consulting engineering practice. He was chairman of the advisory board of commissioners to report on the water supply for Toronto.

JAMES H. STROBRIDGE, emeritus superintendent of construction for the Southern Pacific R.R. and builder of the Central Pacific R.R., died near Hayward, Cal., July 27. He was born in Albany, Vt., in 1827. His first railroad contract was for 2 miles of line for the Naugatuck road in Connecticut. In 1864 he became connected with the Central Pacific R.R. and was later placed in charge of its entire construction program. He was one of the foremost figures in the construction of the transcontinental line when the Central Pacific R.R. and the Union Pacific R.R were united at Promontory, Utah, in 1868. He built the Oakland mole of the Southern Pacific Co.

J. EMILE GIRARD, civil engineer, superintendent and chief inspector of surveys, Quebec Department of Crown Lands and Forests, died recently while en route to Chicoutimi, P. Q. He was born at Becancour, P. Q. In 1901 he was appointed technical officer of the lands department of the Province of Quebec and in 1907 he became assistant superintendent, and 1910, superintendent. In 1911 he was appointed chief inspector of surveys.

S. H. CHATTEN, president and controlling owner of the Union Lumber Co., Union Mills, Wash., died in Kansas City, Mo., recently. He was 58 years old, and was one of the leading lumber manufacturers of Northwest. He was also president of the Southern Lumber Co., Myrtis, La.

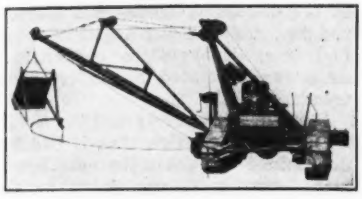
A. B. HOUSTON, for many years superintendent of construction and of the city water works of Decatur, Ga., died July 20. He was 50 years old.

Prepared-Joint Cast-Iron Pipe

Two-inch cast iron pipe, with prepared lead points, ready for calking, are being made by the American Cast-Iron Pipe Co. The pipe is supplied in 5-ft. lengths and may be had with hub and spigot or double hub or double-thread joints. Repair hubs are also available. The company is preparing to supply the same kind of pipe in diameter of 3, 4 and 6 in.

A New Backfiller

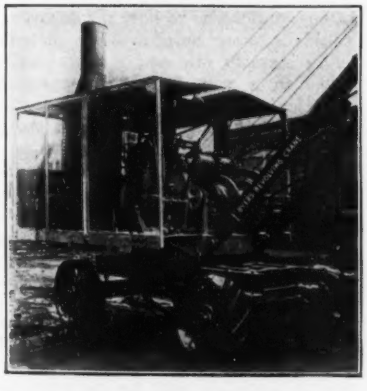
A backfiller with 30-ft. maximum and 20-ft. minimum boom, driven by a heavy-duty 18-hp. four-cylinder gaso line engine, is just being put on the market by the Pawling & Harnischfeger Co., of Milwaukee. It is mounted on



full corduroy treads and is operated entirely by one man. With the boom extended to maximum length of 30 ft., four loads may be filled in per minute. With shorter boom lengths, the number of loads is naturally greater.

New Seven-Ton Road-Type Crane

To round out its line of road-type cranes the John F. Byers Machine Co., of Ravenna, Ohio, is putting on the market a seven-ton "full-revolving" crane. The company is now in a posi-



tion to furnish the road type in three sizes—½ cu. yd. and ¾ cu. yd. "Auto-Cranes" and the new full-revolving, seven-ton unit. As with the other models, the "full-revolving" crane may be had with steam, gasoline, or electric power. Likewise the mountings can be made to suit the customer—road wheels, rail tracks, or single, double, or full-length crawler treads. The machine will handle ⅝ cu. yd. of material with a clam-shell or ¾ cu. yd. with an excavating bucket. It may be equipped with a 4-kw. generating unit and a 36-in. lifting magnet, or with pile leaders for driving or pulling piles.

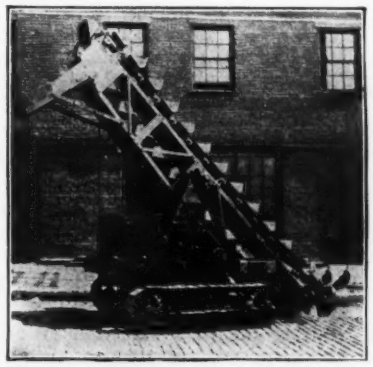
All gears are steel with bronze bushings. To assure sturdy service, 90 per cent of the total weight of the outfit is steel.

An indication of the manufacturer's judgment of the market for this type of crane is shown by the building of a 60 x 120-ft. shop for the manufacture of the new machine.

Wagon Loader Mounted on Creepers

A wagon loader mounted on creepers and especially designed for sturdy service is being built by the George Haiss Manufacturing Co., Inc., New York. It is not a mere adaptation of the Haiss "path-digging" wagon loader equipped with wheels, but is of an entirely new design, heavier and stronger than the wheel-equipped type.

The creepers are 8 ft. long overall and on 6-ft. centers. The loader has a



forward speed of 75 ft. per minute, reverse speed of 45 ft., and a crowding speed of 22 in. per minute, and is equipped with extra-heavy buckets fitted with saw-tooth cutting edges. The height under the chute is 8 ft. 6 in. and when the elevator is collapsed the overall height is 9 ft.

In test these machines have been driven into a clay bank and have excavated it satisfactorily, the task being comparable to steam shovel work. The machine is not recommended for such service, but the test was undertaken to prove the sturdiness of the design.

Scarifier-Grader

Scarifying and grading old gravel stone or macadam roads and streets in one operation, or using scarifier and grader independently, is possibe with the use of the Adams scarifier-grader No. 8A, manufactured by J. D. Adams & Company, Indianapolis, Ind. The main grader drawbar is made of two 3 x 3 x 5-in. Z-bars with a wide spread at the rear end. The grader has a length between front and rear axles of 15 ft. a front wheel tread of 3 ft. 6 in. and a rear wheel tread of 5 ft. 9 in. The front wheels are 30 in. in diameter with a 6 in. tire and the rear wheels 36 in. with a 6 in. tire. The blade of the grader is 8 ft. long, 18 in. wide, with the moldboard. The scarifier makes a cut 45 in. wide. The teeth are seven in number, 3 in. x 1 in. x 20 in. in length.

"Steam Hoe," for Trench Excavation

The "Steam Hoe," built by the Ball Engine Co., of Erie, Pa., for trench excavation work, might be described as a "back-acting steam-shovel," for the dipper moves toward the machine in digging, and fills with a "hoe" motion, instead of being hoisted upward and outward.

The hoe backs away from the trench as it digs. Thus it works always on solid ground, instead of being supported on a platform over the excavated trench like a steam shovel, with the consequent danger of cave-ins. The new machine also does away with much of the trench bracing.

Equipped with a 22-ft. dipper handle, the machine digs a trench as deep as 14

ft. When digging a trench of this depth, it is best to carry the boom at 40 deg. with the horizontal. At this angle, the Hoe can dump material 13 ft. 9 in. above grade and 33 ft. from the center line. Excavated material is piled high, well away from the trench. By means of a power-driven, worm-gear-operated boom hoist the boom can be quickly set at the most effective digging angle. The manufacturers state that in earth and gravel, an output of 200 to 300 cu.yd. a day can readily be counted on.

It is furnished with either traction wheel or crawler-type mounting, and is readily converted into a steam shovel or a locomotive crane, or can be rigged with a dragline bucket.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Building in American Cities

The civic development department of the Chamber of Commerce of the United States has recently made known the results of its investigation of building in the United States during 1920. Information was sought from cities of over 25,000 inhabitants. On the cities of this class which represent a population in excess of 37,000,000, partial or complete reports were received from 131 cities representing a total population in excess of 30,000,000.

The figures compiled by the chamber indicate that in 1920, 70 per cent of the families provided for got one-family dwellings, 11 per cent, two-family dwellings, and 19 per cent apartments in multi-family dwellings. It is also shown that the proportion of multi-family dwellings that were provided in 1920 was largest in the small cities which have not had as much experience with this type of habitation. More house building in proportion to population was found in the smaller than in larger cities.

Of the estimated $1,043,000,000 spent on buildings in 1920 in the cities reporting over 36 per cent were devoted to dwellings. Factories and workshops came second with 16.8 per cent; stores and mercantile buildings third, with 13.3 per cent, while office buildings and garages tied for fourth place with 8.2 per cent each. Schools, hospitals, and charitable buildings together called for an expenditure in excess of $77,000,000. Amusement places cost more than churches, hospitals, or public buildings, or $38,637,000.

Ohio Investigates Freight Rates on Road-Building Materials

The Ohio Utilities Commission started August 3 to investigate the question of freight rates on road-building materials with the view of ascertaining if they were reasonable.

Complaint against the rates was brought by the various associations producing road-building materials, such as the Ohio Sand and Gravel Association, the National Crushed Stone Association, the National Slag Association and the Ohio Paving Brick Manufacturers' Association. George J. Bolender, traffic manager of the Chamber of Commerce of Kalamazoo, Mich., who was instrumental in securing heavy freight reductions in Michigan, has been employed by the Ohio Department of Highways and Public Works. The Ohio Paving Brick Manufacturers' Association was represented by Beecher W. Waltermire, formerly of the Ohio Tax Commission. Evidence adduced showed that rates on all road-building materials in Ohio were higher than in any other state in the union. The case is being watched with great interest by many lines of industry, including all building-material men.

Lumber Production, 1920-1921

Cumulative figures of lumber production, shipments and orders for the first half of the year 1921, according to the weekly trade barometer of the National Lumber Manufacturers' Association, show a decrease over totals for the similar period in 1920, but the figures for the months of May and June, especially in orders, show a substantial increase.

For the period of the first twenty-six weeks of each year the figures are as follows for the seven reporting associations (Southern Pine Association, West Coast Lumbermen's Association, Western Pine Manufacturers' Association, California White and Sugar Pine Manufacturers' Association, California Redwood Association, North Carolina Pine Association and Northern Hemlock and Hardwood Manufacturers' Association): 1920 production, 5,657,274,474 ft. b.m.; 1921 production, 3,851,238,236 ft. b.m.; shipments, 5,115,299,374 ft. b.m., and 3,959,427,201 ft. b.m., respectively, and orders, 4,658,243,117 ft. b.m., and 4,044,635,724 ft. b.m., respectively.

This shows a decline of 1,806,036,238 ft. b.m. in production, of 1,155,872,172 ft. b.m., in shipments and 613,607,393 ft. b.m. in orders.

Pennsylvania Receives Bids on 60 Miles Durable Highways

During the past week the Pennsylvania Highway Department received bids for the construction of about 60 miles of durable highways, most of the projects being reinforced-concrete roads. The bid opening was remarkable in the fact that on the twenty-seven projects involved there were 220 bidders. On one 4-mile job seventeen contractors bid. Another project drew sixteen bidders and another fourteen. The total low bid approximated $3,200,000.

Bids submitted for the building of 31.7 miles of 18-ft. reinforced-concrete pavement aggregated $1,735,314, or an average cost of $54,000 per mile. On 21.7 miles of 16-ft. reinforced-concrete road the bids averaged $45,000 per mile.

Building Plans for July in Manhattan Borough Extensive

The report of Rudolph P. Miller, superintendent of buildings for the Borough of Manhattan, New York City, is to the effect that during the month of July of this year plans were filed for fifty-three new buildings costing a total of $17,878,825, as against 141 costing a total of $6,269,800 for the corresponding month of 1920. The gain is mostly in office buildings. During July, 1920, plans were filed for the erection of nine to cost $2,190,000, whereas during July of this year six office buildings costing $13,500,000 were planned.

Industries Meet With Commerce Department Chiefs

A new opportunity for industry to suggest how governmental statistics and research can be of maximum value to it was afforded July 29 by the Secretary of Commerce when, at his request, representatives of the principal industries assembled in Washington. The invitation was extended through the National Manufacturers' Association. While the conference was called primarily to discuss matters pertaining to the census of manufactures, the whole subject of the department's work came in for discussion during the course of the day. After many angles of opinion had been developed, a committee of nine was appointed to perfect recommendations.

Secretary Hoover opened the meeting with the explanation that it had been determined to gather the next biennial manufacturing census so as to show commodity units, as well as monetary values. He explained that the department is very anxious to gather data which will be helpful without plaguing the industries. In order that this information can be put in a form which will be of practical utility it is the desire of the department, Mr. Hoover said, to consult at every step with those whom it is intended to benefit.

F. M. Feiker, assistant to the Secretary of Commerce, told the assembly that the department had been conferring for a number of weeks with committees from the various industries and trades, and had secured a large number of suggestions as to how the department could be most helpful. The plan now is to classify and apply these suggestions in a way that will be entirely practical.

Among the suggestions that the department is particularly anxious to carry into effect are those indicating how waste in industry can be eliminated and how figures can be made the basis of prophecy rather than possess historical value only. Mr. Feiker explained that the work on elimination of waste is being done by the Bureau of Standards along with its efforts looking to the simplification of variety. He also stated that one effort of the department will be to bring into closer touch the associations representing the buyer and the associations representative of the seller.

Ohio to Open Road Bids Aug. 19

The Ohio Highway Department will receive bids Aug. 19 for the construction of 20 miles of durable type paving and a bridge estimated to cost $870,443. Including the bridge, thirteen projects are involved. The projects cover the construction of 5 miles of brick paving, 11 of concrete, and 5 of bituminous macadam.

Refuse Incinerator Bids Asked by City of Philadelphia

The City of Philadelphia will receive bids on Aug. 26 for not less than four refuse incinerator units with a total capacity of 280 tons of mixed refuse and 480 tons of rubbish per 24 hours, to be installed on what is known as the Cambria St. site. The plant is to be so designed as to be capable of burning garbage with rubbish, or rubbish alone.

The city proposes to erect the building, the runway leading to it, and the chimney. The bidder is to furnish plans and specifications for the incinerator foundations and to state the capacity and sections of the chimney required.

It is the intention of the city to dispose of all garbage and rubbish delivered to this plant from the districts it is intended to serve. One of its purposes is to relieve pressure upon the garbage reduction plant, but mainly to eliminate the present long haul involved. It is not the intention to close down the garbage reduction plant, which is now owned by the city, together with wagons, equipment and other paraphernalia formerly owned by the contractor.

Frank H. Caven is director of public works and Fred C. Dunlap is chief and J. H. Neeson deputy chief of the bureau of highways under the department named. Samuel A. Greeley, Chicago, is the consulting engineer.

Car Loadings Show Heavy Grain Movement

An increase of 14,096 in the number of cars loaded with revenue freight on American railroads during the week which ended on July 23, compared with the previous week, was shown by reports just received from carriers by the car service division of the American Railway Association. The total for the week was 790,348 cars which was, however, a decrease of 138,070 cars compared with the corresponding week last year, and a decrease of 119,334 cars compared with the corresponding week in 1919.

The principal increase during the week of July 23 was in the loading of grain and grain products, which totaled 64,919 cars or 7,928 cars more than during the preceding week. This total was 29,442 cars greater than that for the corresponding week in 1920 and 13,374 cars in excess of that for the corresponding week in 1919. It also was 7,804 cars above the peak loading of any week since January 1919, which is as far back as the records go.

Building Gains Impetus

In analyzing employment conditions during July the United States Employment Service reports that "general building operations are gathering impetus steadily and, while marked activities in this line are still somewhat sporadic, construction programs of greater or less magnitude are maturing gradually in practically all parts of the country."

General Electric Company Cuts Wages at Lynn Plant

A wage reduction of about 12 per cent and affecting approximately 12,000 employees of the General Electric Company, at the Lynn, Mass., plant, was announced last week and became effective Aug. 7. The cut will vary with different classes of employment, and was decided upon after a conference between company officials and representatives of the employees composing the general joint committee on adjustment, when means to secure continued operation of the various departments of the company's business were discussed.

San Francisco Building Situation Gradually Improving

The American plan is now an accepted fact in San Francisco except among certain unions and the building trades council leaders who are reported to be endeavoring to precipitate a general strike. The Industries Association of San Francisco with a determined purpose to maintain permanently the American plan, has completed its organization, has adequate funds for carrying on its work and has as officials some of the best known San Francisco business men. Previous reference to the formation of this organization appeared in *Engineering News-Record* July 21, 1921, p. 128.

There is a shortage of skilled workers in certain lines of the building trades which is delaying progress but work is under way on all principal jobs. The builders exchange has brought in large numbers of workmen under contract and many more have come in unattached. A guard system is maintained on all jobs by the builders exchange and there has been no appreciable disorder.

Unemployment Relief Work Provided at Racine, Wis.

Municipal work for 300 unemployed heads of families was started at Racine, Wis., Aug. 1, on street, park and cemetery improvements for which a bond issue of $150,000 has been provided. The wage is 35c. an hour and the men are employed six days a week or less, according to their needs. H. G. Presser, local head of the U. S. Employment Bureau, is connected with the relief work, which is said to have originated with the Racine Commercial Club and to have been backed by other organizations, while a special committee of the City Council planned what work should be undertaken.

Cement $2.40 Net, Alongside Dock, New York

Cement still sells for $2.40 net, alongside dock, New York. Through a typographical error it was given in the latest monthly list of material prices as $2.15, which is the price at the mills supplying the New York district. It can be bought delivered in New York for $2.60, which allows the dealers an extremely narrow margin, as handling charges are 35 to 40c. per bbl.

Seattle Votes $5,500,000 More for Skagit Project

On July 26 the Seattle City Council by a vote of 7 to 2 approved a measure authorizing another $5,500,000 bond issue with which to finance work on the Gorge Creek plant of the Skagit project. The action of the council was immediately approved by the mayor. This makes a total of $11,000,000 in bonds thus far issued for the Skagit work.

Concrete Road Contracts Average Less Than $30,000 Per Mile

During the past week the Illinois Commission of Highways let contracts for the construction of 112 miles of concrete roads for an aggregate price of $2,318,238. This is an average of $20,700 per mile excluding the cost of the cement which is furnished by the state. With the cement the highway will cost considerably less than $30,000 per mile. Contracts for 20 miles more were awarded at the same time, but no prices were mentioned. The 112 miles are divided among thirty projects.

British Government Announces Housing Policy

(*London Correspondence*)

The British Government has decided that the number of houses to be constructed by local authorities and by public utility societies with government assistance under the present scheme will be limited to 156,000, that being the number building and for which tenders have been approved. Under the subsidy scheme for private builders the number of houses built or to be built is estimated at near 23,000.

The annual cost to the state under the local authority and public utility society schemes is about £10,000,000 per annum, and the amount required for the payment of subsidies to private builders about £5,000,000 per year.

The construction of houses now building or yet to be built under the government housing scheme will utilize all available labor for at least twelve months, including a considerable number of ex-service men yet to be absorbed by the industry.

Civil Service to Appoint Production Engineer

Examinations for appointment as production engineer in the hot metal division of the naval ordnance plant, South Charleston, W. Va., and vacancies in positions requiring similar qualifications are announced by the United States Civil Service Commission. Applications may be received up to Aug. 30. The appointee must have a general practical knowledge of raw materials, melting, forging, heat treatment, and machining of guns, projectiles and armor plate, and must understand the sequence of factory operations and be able to compute cost and time studies. The appointee to the vacancy in the South Charleston plant is to receive $9.76 per day. Applicants should apply

at once for Form 1,312 to the Civil Service Commission, Washington, D. C., or other qualified individuals and agencies indicated in the announcement circular, No. 361.

Low Bids on Road Jobs Far Below Engineer's Estimates

Last week the Ohio Highway Department received bids for the construction of about 10 miles of highways and for the building of a bridge which totaled but 77 per cent of the engineer's estimate. The total low bid was $496,435, while the total estimate was $644,549. On one small project the estimate was $2,034 and the low bid $1,087.

Increase in Unemployment Is 1.1 per Cent for July

According to the monthly figures compiled by the employment service of the U. S. Department of Labor there was a decrease during the month of July of 1.1 per cent in employment throughout the United States in selected industries. The figures are gathered monthly in sixty-five industrial centers from 1,428 firms, each normally employing more than 500 workers. The total decrease in employment for these centers since Jan. 1 has been 7.3 per cent. Industries reporting increases are automobile manufacturers, railroad repair shops, textiles, lumber, tobacco and paper and printing.

Contracts for the Week Total More Than $23,000,000

The total value of contracts let during the past week, as reported in *Engineering News-Record*, was $23,330,900. Street and road contracts were not so large as in previous weeks but the amount of proposed work reported indicates that no cessation in the letting of highway contracts is to come yet. The value of miscellaneous building contracts is above the average.

Two of the principal contracts let were for the construction of the first unit of the marine terminals at Wilmington, Del., for $1,372,570; and a grain elevator at South Deering, Ill., the contract price being about $4,500,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 4, the next, on September 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.88	−$3.50	$4.30	$3.03	−$3.16	−$4.10	−$3.70	−$4.00	$5.00
Structural rivets, 100 lb	4.40	5.25	5.75	4.03	5.20	−4.25	−5.50	5.50	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.78	−3.20	−3.50	2.93	−3.18	−3.97½	2.35	4.00	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	51%	52.65-5%	45%	58½%	53.9-5%	36%	−46.25%	47½%	5%
Cast-iron pipe, 6 in. and over, ton	48.30	43.33	57.50	49.10	−52.80	−57.50	−60.00	63.00	75.00
Concreting Material:									
Cement without bags, bbl.	2.60@2.70(del.)	2.75	2.80	2.17	2.41	3.10	3.09	3.10	2.75
Gravel, ¾ in., cu.yd	2.25	2.25	3.00	2.25	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.35	2.50	2.25	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.90 to 2.00	2.25	2.80	2.50	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	38.00	35 00	55.00	35.00	47.00	27.00	−21.00	120.00
Lime, finishing, hydrated, ton	16.99	19.00	25.00	20.00	29.00	32.00	25.40	24.00	28.00
Lime common, lump, per bbl	3.79	1.50	2.75	1.65	1.50	3.10	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	10.00	12.65	12.00	17.00	14.00	18.00	14.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	13	.09475	.092	.09	.12½	.11	.15
Hollow partition tile 4x12x12, block	.1232	.14	.13	.07410	.092	.10	.14½	.12	.....
Linseed oil, raw, 5 bbl. lots, gal	.80	.85	.97	.87	.91	+1.01	+.98	.79	.84
Common Labor:									
Common labor, union, hour	.75@.80	.35	.....	1.00	.50	.50@.63½	.81½	.75	.....
Common labor, non-union, hour	.....	.20@.25	.35@.45	.40	.50	.37½@.50	.50@.55	.50	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 300-lb. bbl.; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.60 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime; white is 15c. additional. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds, exchange with the United States being 14 per cent at present. Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment.

Changes Since Last Week

The attitude of the steel industry is to quote attractive prices on large orders. There is little new business in the fabricating shops, and the official price of $1.85 per 100 lb. applies only to small tonnages. Mill shipments of shapes, New York, cost $2.18 to $2.23, with warehouse charging $2.88 delivered. Since our last weekly resume, prices have declined in Atlanta, Minneapolis, Denver, San Francisco and Seattle. The heaviest decreases were in San Francisco, 55c. and Atlanta, 50c. Rivets are down 30c. in San Francisco. Reinforcing bars are down in five of the nine cities from which we obtain quotations. Bars from stock cost $3.50 in Dallas, with mill shipments at $3.10.

Steel pipe has changed only in San Francisco, but cast-iron pipe is down in New York, Minneapolis, Denver and San Francisco. Last week we quoted $70 for cast-iron pipe in San Francisco, this week, $60.

The cement situation continues unchanged throughout the various cities, awaiting lower mill prices; the same conditions applying to the other concreting materials—stone and sand.

Douglas fir is down $1 per M. ft. in Seattle. Linseed oil has advanced 5c. in Denver and 2c. per gal. in San Francisco.

Non-union common labor is obtainable at 20 to 25c. per hour in Atlanta. In order to stimulate construction work in Central Ohio the Columbus Contractor's Association has demanded that carpenters reduce from 90 to 80c. per hour; bricklayers from $1.25 to $1. The hoisting engineers have already reduced to 80c. per hour.